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THE OIL WEEKLY

WORLD OIL

SPECIALIZED FOR EXPLORATION, DRILLING, PRODUCING,
PIPE LINE OPERATIONS AND MANAGEMENT

FEBRUARY 1, 1953

Sawyer's Report And Foreign Oil Investments

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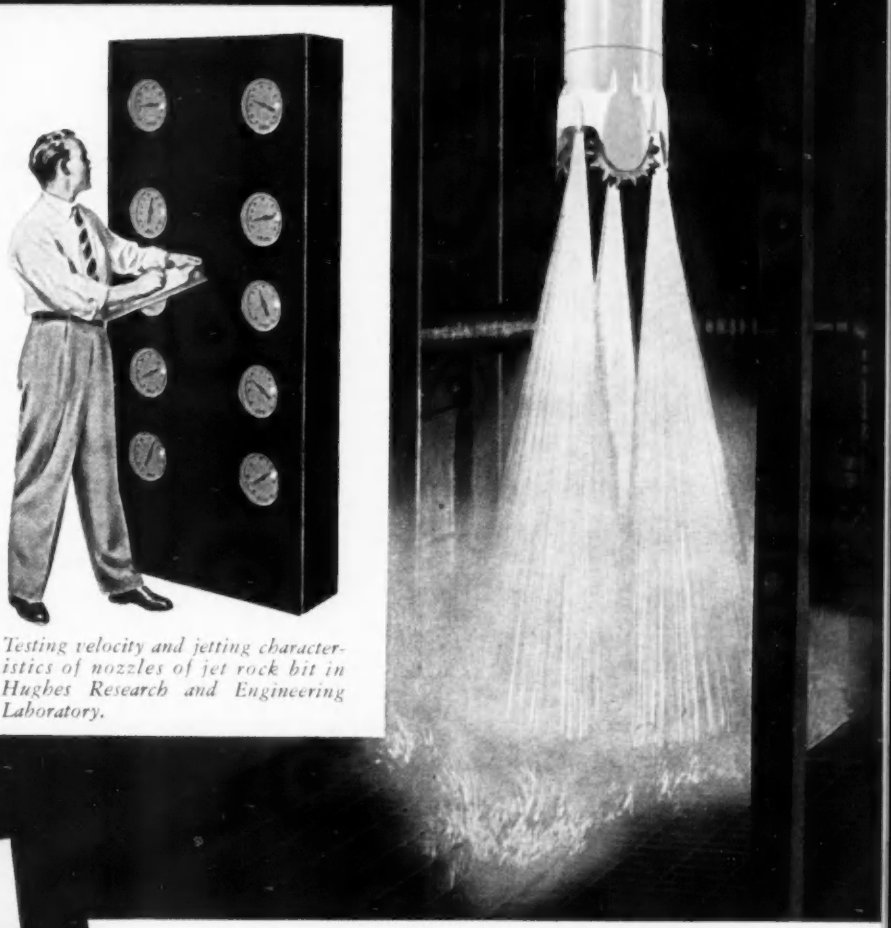

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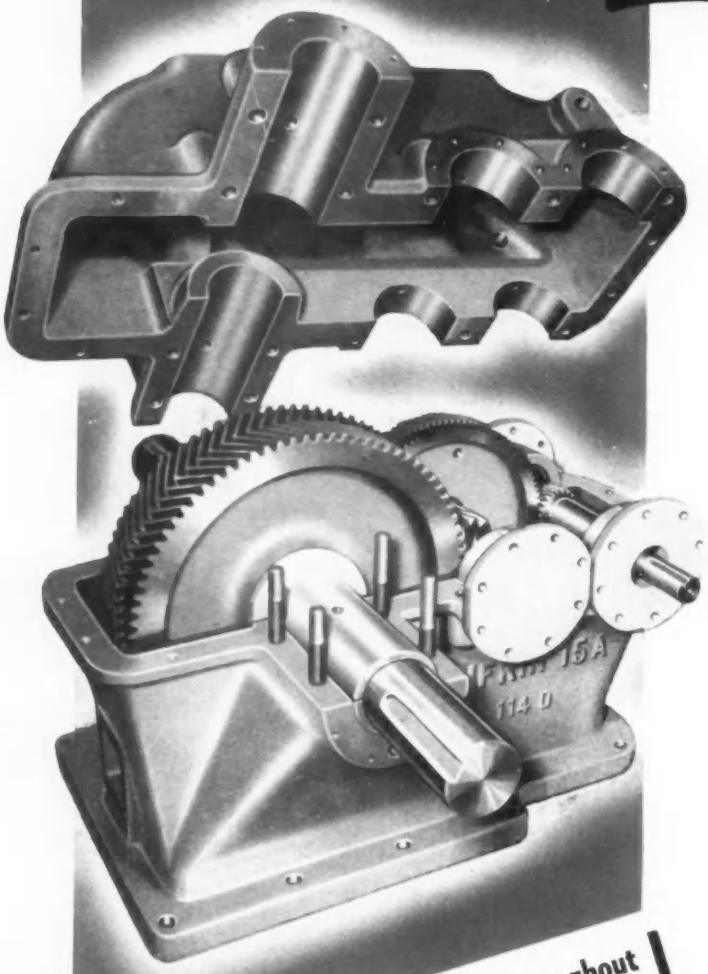

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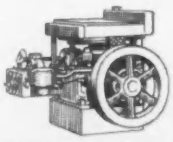

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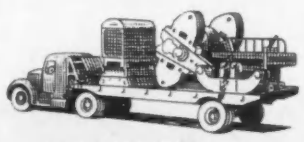

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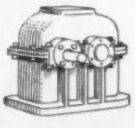

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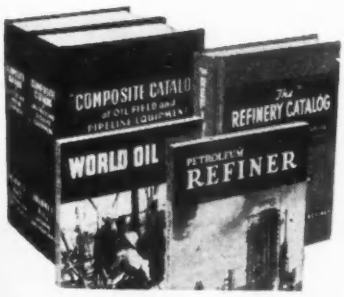

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WORLD OIL and The COMPOSITE CATALOG for the drilling-producing-pipe line industry
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A Quick Guide to

WORLD OIL this month . . . .

Current Outlook

More Oil Needed in '53. Total demand for all oils in 1953 will average 8 million barrels daily, according to the Bureau of Mines forecast. This is an increase of 3.8 percent over '52. A review of the bureau's '53 forecast is on **Page 50.**

Insurance Rates Jump. Texas compensation insurance rates have risen and drilling contractors are fighting the increase. However, they agree with insurance carriers that rates can be brought down all along the line if employers use their influence to have compensation laws amended during current session of the Texas Legislature. For an analysis of a deplorable situation that is costing Texas employers millions of dollars annually in insurance payments, see **Page 55.**

Are Lease Operating Expenses Too High? If so a methods study may be in order. Here's an article based on studies made by a major oil company and designed to effect better coordination of working groups, save time and physical effort, improve working conditions and assure more efficient use of tools, material and equipment. **Page 60.**

Competition Is Getting Tougher. The petroleum industry is returning to normal. The boom that followed World War II and kept alive by the Korean conflict is subsiding. Supplies are exceeding demand. Prices are sagging below ceilings. WORLD OIL's L. J. Logan reviews the petroleum picture on **Page 66.**

Politics and Oil Won't Mix. How long can the free world's growing appetite for oil be satisfied? Economist Max W. Ball says the stumbling blocks are political and not geological. **Page 67.**

Exploration

This Is Worth Thousands of Words. That's the value often placed on a good geological cross-section. Two cross-sections are worth twice as many words. Geologists, engineers and operators will get a vast amount of information with a minimum amount of reading by examining the two Pennsylvanian cross-sections of Central Oklahoma presented this month by WORLD OIL. **Page 83.**

Seismologists Get Credit in Alberta. Effective application of the seismograph method in elucidating specific problems within a particular area often involves variations of standard field and interpretation techniques. Such is the case in Alberta, Canada. In locating reefs in this area, modifications have been introduced successfully. For a description of these modifications and their application, turn to **Page 86.**

Oil Detected Directly. Men long have sought some way to find oil directly rather than by first finding structures that may be traps for oil accumulation. Such a method has been developed and tried out successfully. Although it has its limitations, this new method has proved its ability to assist in a better evaluation of prospects. An electromagnetic method, the new technique indicates the presence of oil in its underground reservoir by measuring the resistivity of subsurface formations from the ground surface. **Page 93.**

Drilling

Running and Pulling Pipe Under Pressure. Although not a new technique, it has been suggested that running and pulling pipe under pressure is not understood generally. Here's an article that tells how it's done and where it will do the most good. Whether you have operations in the shallow fields of Yates or the deeper, high-pressure areas of the Gulf Coast, there are advantages of "snubbing pipe." **Page 111.**

Use this condensed information on this month's principal articles. Run through these digests rapidly. ✓ Check. those you want to read first.

Do You Understand Electric Logging? This has become a most valuable tool to geologists, engineers and geophysicists. Yet too many users have only the vaguest notion of what they are measuring. Here's a clear-cut approach to a complicated subject. It's an attempt to explain in simple language what determines electrical conduction by rocks and the resistivity of a fluid-saturated rock. The first of two parts begins on **Page 113.**

✓

Drillers Are Becoming "Winter-wize." And the word winterize is becoming significant in oil-field parlance. With discoveries in Canada and the Williston Basin, operators are having to deal with severe cold weather conditions. For a report on progress made in cold weather operations and *"How They're Whipping Williston's Winter,"* turn to **Page 120.**

✓

How to Save Drilling Line and Time. A simple installation requiring a cable tool drilling clamp under the derrick substructure will speed up the process of cutting drilling lines. Every toolpusher will be interested in finding out how the laying down of blocks and possible line slippages can be eliminated. **Page 124.**

✓

Do You Want to Cut Drilling Mud Bills? Here's how substantial savings were made as a result of a carefully planned mud program. An experience you can benefit by. Suggestions are offered which will be applicable in areas of salt sections, anhydrite stringers, zones of lost circulation, sands and conglomerate. It's an article every toolpusher and driller should read. **Page 134.**

It Is Economical to Be Safe. The company with a good safety record economizes on its insurance rates and reduces waste of time, machinery and man-hours. The author, an insurance executive, gives a dollar-wise approach to a problem that is definitely an important operating procedure. **Page 140.**

► Production

Subsurface Pressures Tell the Story. A good drill stem test gives the operator a great deal of information . . . whether the well is a commercial producer, shut-in and flowing pressure, etc. But these data are useless if the test was not a good one. How to tell? Subsurface pressures recorded when making drill stem tests reveal more than meets the eye. How to make a good interpretation of such charts is told in *Subsurface Pressures Tell the Story in Drill Stem Testing.* **Page 155.**

✓

Something New in Well Completions. Two full size tubing strings succesfully run simultaneously in a dually-completed gas well. In expensive marine wells this new method offers many advantages. It can be applied with equal success on land wells. How the problem was solved, design of equipment used and installation procedures are described in *Dual Completion Takes Two Full Size Tubing Strings* beginning on **Page 162.**

✓

Are Your Lifting Costs High? If costly shutdowns to replace or repair corroded equipment are eating into your profit, here are some helpful hints. Dan H. Carpenter, a corrosion specialist with Sohio Petroleum

Coming February 15 . . . WORLD OIL's 3-in-1 Extra!

WORLD OIL's annual Review-Forecast Issue is a 3-in-1 "extra" which summarizes in detail the past, present and future of all phases of the state, national and international petroleum industry. Months of preparation go into the production of this special issue, which over the years has earned for itself a position of confidence and merit in the industry.

In addition to regular departments, the Review-Forecast Issue contains authoritative analyses of the petroleum industry's current outlook and trends on supply and demand, exports and imports, crude stocks and prices and steel. Prospects for exploration, drilling, production and pipe lines are included.

Comprehensive tables and charts projected with outlook trends and supported by review data are supplied for each analysis. On the international level, the Review-Forecast Issue offers resumes of 1952's activity and analyses of world supply and demand, reserves and production.

It is in this issue that WORLD OIL offers a summing-up and forecast aimed at the "pocketbook" interest of both company official and field employee—all directed toward a single end: that the oil man, whatever his status may be, can be adequately appraised of what the industry holds for him, his company, his nation and the world. Watch for it . . . Feb. 15!

Company, has outlined the basic causes of corrosion and tells what can be done about it. He may have the answer you need. **Page 172.**

√

Some Ideas for Planning a Water-Flood. If you're planning a water-flood or re-designing an existing one, here are some valuable suggestions. Another company's experience in water-flooding is always a valuable asset. There's a wealth of information in *Nowata Water-Floods Use Modern Techniques.* This article describes four projects in northeast Oklahoma. The report includes history, completion practices, operating methods, source and treatment of flood-water and results. **Page 178.**

√

A Simple Method of Computing Permeability. Permeability of a natural gas reservoir may be established from performance data taken on the reservoir. A simple method of computing the permeability from a draw-down curve is presented and sample calculations given by Dr. David Cornell of the Texas Petroleum Research Committee in his article *Permeability Determined From Production Data.* Experimental data necessary for the computations may be obtained conveniently as part of a routine back-pressure test. **Page 186.**

Pipe Line

Pipe Line Progress in '52. Many advancements in pipe line technology during 1952 have been revealed in a survey of companies. Outstanding achievements in electronics, determination of interfacial cuts, automatic controls, station construction, metering and mechanical products separation. They're all rounded up in a word-and-picture review starting on **Page 201.**

√

You Asked For It . . . a Corrosion Engineer's Field Manual. Pipe line corrosion engineers advised WORLD OIL of the need. The editors arranged for Marshall E. Parker, a corrosion engineer and author of many technical papers, to write it. The manual will run in 12 parts. The first starts this month on **Page 210.**

√

Pity Poor Pete . . . as he continues his misadventures and learns that fooling around with an old drum without steaming out vapors is a good way to drum up business for the undertaker. And this hard-headed guy now knows to use a soft-headed hammer when working on hardened carbon steel. **Page 217.**

Bill's Keeping Busy. At the tender age of six months, W. C. Kinsolving's parents packed him in the family buggy and made the trek from Corsicana, Texas, to the fabulous Spindletop oil field at Beaumont, Texas. And Bill has been on the go since. Now president of Sun Pipe Line Company and holder of various other titles, Kinsolving explains his success among the rowdy pipeliners of the early 20th century . . . "I talked the loudest, did the least work and thought up schemes . . ." Today he's still talking; still thinking up schemes; and busy at his job as one of the leaders of the industry. **Page 224.**

International

Morocco Looks to the Future. Strategically-located Morocco is a rich country on the eve of becoming a major oil-producing nation. Just how strategic and how rich is explained in an article beginning on **Page 235.**

√

Global Oil and Trouble. Big companies must find oil abroad. And added to a long list of inherent obstacles are an uncooperative government in the U. S. and an uninformed public at large. The petroleum industry could take steps to educate the public. And it should. See the conclusion of a two-part article starting on **Page 239.**

√

The Sawyer Report and Foreign Oil. Retiring Commerce Secretary Sawyer and his special committee have appraised Western Europe's economic situation in a most un-New Dealish manner. Their report, upon return from Europe, set forth findings and considerations which can have great bearing on the oil industry abroad. **Page 242.**

√

What Does Sturgeon Lake Find Mean? The Sturgeon Lake discovery last August was a significant one for Canada. To find out just how it fits into the generally expanding Canadian oil and gas scene for production, drilling and completion data, turn to **Page 246.**

√

Payoff in Canada. Canadian safety and education programs are paying off. A reduction in compensation rates of 50 cents per $100 of payroll will be in effect this year, thanks largely to efforts of the Canadian Association of Oilwell Drilling Contractors, Workmen's Compensation Board, the University of Alberta, and the Western Canada Petroleum Association. See A WORLD of OIL by International Editor Don Kliewer on **Page 252** for this and other reports of interest to the oil industry.

Looking Ahead

Oil and gas companies face continued scarcity of engineering manpower. Many lines need engineers. Technological progress requires increasing number of engineers. They are wanted faster than universities turn them out. To alleviate scarcity, management can do much, especially by "stretching" engineering manpower. Executives should relieve engineers of jobs that can be done by technicians and others and save engineers for strictly engineering problems. Some experts say that instead of one technician now employed in industry to every two engineers, there should be ten technicians to each engineer.

Spraberry field of West Texas is due for some relief in new 80-acre well spacing rule. It will help increase oil recovery per well and make development more feasible. Area has more than 2000 wells on approximately 400,000 acres in several counties. It may eventually comprise 2 million acres, though low recovery per well has retarded development.

Health and welfare benefits for members is current objective of Oil Workers International Union (CIO). Union initiated campaign with proposal that Union Oil Company of California pay in for this purpose 7½ cents per hour for each employe.

Ending of oil price controls probably would not result in any price increases except on Pacific Coast and possibly for Pennsylvania grade crude and derivatives. In thoses cases increases are needed to stimulate supply.

Continued controls on materials are needed. That's the feeling of some oil industry leaders. They foresee a continued need for PAD as long as materials controls in general are maintained. Otherwise the industry would not get its rightful share of materials, they say.

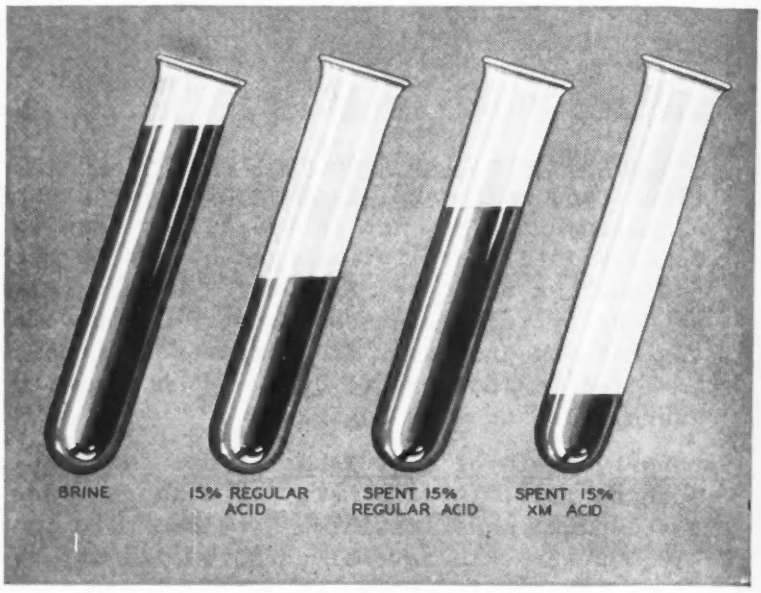
Natural gas demand will climb as old customers use more and new users appear. Huge market will be provided by remodeling of obsolete homes as well as building of new homes. Utilities and appliance makers are "selling" a whole "family" of gas appliances, including gas water heaters, refrigerators, clothes dryers and incinerators, as well as cooking, comfort heating and air conditioning equipment. Sales in 1953 should exceed the $1¼ billion of 1952, thanks to more materials.

Atomic power may be pushed toward industrial exploitation in present session of Congress. There is growing sentiment that Atomic Energy Commission, now spending $4 billion for military purposes, should allocate a few millions for experimental industrial facilities. For such cost an atomic plant could be generating electricity within a few years. It would provide valuable information on economic feasibility of atom-generated power.

Natural gas is principal fuel for public housing projects to be started early in 1953. Of 21,000 family units in 31 states, costing $220 million, 69 percent will be heated by gas, 72 percent will get hot water by gas and 83 percent will have gas stoves.

GET MORE PRODUCTION FROM YOUR ACIDIZING

Acid treatments can be tailored to formation characteristics by using Dowell addition agents



This drawing illustrates the swelling-control effect of XM Acid on silicates. The same quantity of silicates has been placed in each of four different solutions. Note the relative volume occupied by the silicates in each case.

Successful acidizing is more than just a matter of pumping acid into a well. The real pay-off in increased production comes only when the *right* chemicals are used.

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For example, Dowell XM Acid is designed to reduce the swelling of silicates of the clay type minerals found in certain dolomite and limestone producing formations. This silicate swelling, during conventional acid treatments, can delay well clean-up and actually reduce oil production.

A well completed in a dolomite formation known to contain swelling silicates was producing 15 BOPD. A Dowell XM Acid treatment boosted production to more than 80 BOPD . . . an increase much higher than could be expected with ordinary acid. After 60 days, production had leveled off at 60 BOPD. Treatment payout time was estimated at 3 days.

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Editor's Page

Higher California Prices Needed

HIGHER PRICES for both crude and refined products in the West Coast area is one of the outstanding needs of the industry. Higher prices are necessary to solve the region's petroleum shortage. The Office of Price Stabilization should grant higher prices ceilings immediately.

The need for increased oil prices exists throughout the country. Despite higher operating costs, no increase in oil prices has been permitted since 1947. However, the situation is especially acute in California.

The West Coast has been called upon to furnish the bulk of the oil needed by military services in Korea. This added to enlarged industrial and civilian use, also partly due to the area's location with respect to Korea, has created a demand which exceeds the West Coast's ability to supply.

• • •

A SHORTAGE OF OIL will continue to exist on the West Coast as long as the government refuses to permit increased petroleum prices. The situation has been growing steadily more acute instead of improving. Military services have found it necessary in recent months to purchase 50,000 barrels of products daily from the Gulf Coast. Meanwhile, California oil companies have stepped up the importation of foreign crude to something like 60,000 barrels per day. Both of these are inefficient and uneconomical operations. It would be more advantageous and cheaper if steps were taken to increase California's oil supply.

Basic cause for the present inadequacy of West Coast supplies are the low levels at which oil prices were frozen. In view of higher operating costs, they are not sufficient to provide adequate incentive for discovery and development expenditures of the magnitude required by the situation.

• • •

THE WAY TO OVERCOME this situation is for the Office of Price Stabilization to grant the present plea for higher California prices. Such remedial action should have been taken long ago. The shortage has existed ever since the Korean military action imposed heavy demands on the area's supply 2½ years ago.

OPS has continually refused to grant higher price ceilings despite repeated appeals of California oil companies and operators. Better prices will encourage more intensive development, but cannot improve the situation overnight. It will take some time for the benefits of greater development activity to be felt in supply quantities.

Therefore, it is highly desirable that OPS takes favorable action at this time. It is long overdue.

Warren L. Baker

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Success in cementing means only one thing—to secure a leak-proof water shut-off with the initial cement job—and Baker Floating Equipment offers you the best possible opportunity to secure such success. Let us consider the features of Baker Equipment which contribute to Successful Results... Seamless steel collar stock, threaded to *exactly* fit your casing, is a long-time Baker "Standard." The rounded nose of all Baker Shoes is made of "Baker Formula" Cement, and will safely guide the casing past all side wall irregularities. The famous Baker Buoyant Ball permits free passage of the cement slurry; then, at the slightest reversal of pressure, floats to a leak-proof seal against the recessed, abrasion-resistant rubber ring.—All internal construction consists of easily drillable materials, with *no metal* to drill out or to interfere with diamond coring immediately below the shoe. The bit meets the very minimum cross-sectional area of plastic (and no metal) when drilling out, and quickly reduces the cement and plastic to harmless fragments which circulate out of the hole.

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This exclusive Baker development is widely used by operators who are willing to pay slightly more for this added assurance of success, especially when bridges are present in the hole. The baffled side ports in Baker WHIRLER Equipment direct the fluid at an angle against the walls of the hole, and this action combines with the hydraulicking effect of the fluid through the bottom of the shoe to remove bridges and permit safe landing of the casing. In addition, the well is conditioned to permit bonding of the slurry with the formation.

"First" in Popularity

Here is a "First" possible only because you (and thousands of other operators) have been quick to recognize tools and methods which *provide dependable performance*. It is both a challenge and an inspiration to work with men who *insist upon results*—a challenge to supply their present needs, and an inspiration to meet their demands of tomorrow. Baker will always be ready!

BAKER OIL TOOLS, INC., • Houston • Los Angeles • New York

NO METAL • NO TRICKS • NO TROUBLE DRILLING OUT

This is Product No. 100—Baker Cement Float Shoe—outstandingly "First" for the safe guiding, floating and cementing of casing. No other shoe approaches its world wide popularity. Available also in the "Whirler" Type at a nominal increase in price.

This is Product No. 102—Baker Cement Guide Shoe. Used in combination with a Baker Cement Float Collar when one float valve is considered sufficient, and a stop for the cementing plug is desired above the shoe.

This is Product No. 101 M & F—Baker Cement Float Collar—usually positioned just above the shoe joint to provide a "stop" for the cementing plug. Used in combination with any type of Baker Cement Shoe selected to meet customer's specifications.

Brings "LASTING" Results

Mid-Continent Oil Operators Favor Aggressive Program

AN AGGRESSIVE exploration and drilling campaign is favored by Mid-Continent oil operators. Budgets being prepared indicate that major companies will give independents as much support as in 1952, or more. Spot checks among operators in other oil provinces indicate similar plans.

There is a feeling of optimism, engendered by the change in administration, and oil men feel that they can give more attention to finding new reserves and less time to fight for the rights which New Dealers attacked at every opportunity and in each New Deal-dominated Congress.

However, whether the oil industry will drill as many wells in 1953 as in the past year—and despite its willingness to do so—is problematical. Several months ago the Petroleum Administration for Defense called for 55,000 wells for 1953. But industry, in its sober judgment, believes it will have a difficult time to attain this goal.

As usual, steel shortages represent the bottleneck in achieving the 55,000-well goal. Steel manufacturers point out, however, that the real bottleneck is not steel itself but facilities to convert steel into oil field tubular goods. This is an argument which waxes strong whenever oil men and steel men get together

The oil industry completed approximately 46,000 wells last year, against nearly 45,000 in 1951. There is no doubt the industry could have achieved its goal of 50,000 wells last year but for the steel strikes which reduced pipe manufacture.

But even with increased steel capacity, industry leaders feel they will not be able to attain the 55,000-well goal which has been set. In a recent IPAA survey a steel shortage of 300,000 tons was predicted. The survey shows inventories depleted, with little second-hand or salvaged pipe to be available this year. Indicative of the trend to hoard pipe are numerous instances in Oklahoma where operators decided not to set pipe on sands which appeared doubtful. There are a large number of "temporarily abandoned" wells which may some day be completed as producers if and when the pipe situation eases.

Representatives of the steel industry want controls abolished after the first quarter, but PAD spokesmen favor extending the controls period until the middle of 1953. Leaders in steel predict an over-all surplus of steel by the middle of the year, but hasten to point out that even with sufficient steel, the oil industry must continue to suffer from tubular goods shortages because, as pointed out earlier, the steel industry does not possess sufficient pipe rolling capacity to meet the expected demand. Independents, generally, favor decontrol as soon as possible, claiming they can hold their own in the scramble for pipe.

Wildcat wells were deeper on the average during 1952, and there were no spectacular discoveries, in spite of publicity given development in the Williston Basin.

The IPAA recently told its members that increased imports of foreign oils will not be needed to meet demand for petroleum products in 1953. In this connection, the IPAA pointed out that imports averaged 1,081,000 barrels daily in December and if this trend holds through 1953, reduction of domestic production will be necessary to prevent flooding of the market and creating excess crude stocks. On the other hand, exporters maintain that there is no threat to the domestic market, and several major oil-importing companies declare there will be no material change in policy or quantity of imports this year. This issue, as in the past, will continue to excite discussion in both camps—the independents and the companies which have crude that must be exported. It is doubtful if 1953 will see a solution to this problem.

Texas Asks Importers' Estimates for '53

THE STATEWIDE TEXAS Railroad Commission proration hearing February 18 will hold major interest for Texas oil men, with overtones of national and international importance.

At this meeting crude purchasing and importing companies have been invited to review 1953 estimates of required crude and products stocks. Ernest O. Thompson, the commission's chairman-elect for 1953-54, believes increasing imports are adversely affecting domestic drilling. To support that belief, he has pointed to a drop of almost 2000 drilling permits in 1952 from the total of 18,055 issued the previous year.

The commission thus is turning to purchasers and importers again in a continuing effort to ascertain demand for Texas oil, and their views on estimated requirements is a stepping-stone in a prudent approach to this one phase of the commission's job.

This invitation was issued after the commission set the Texas crude allowable for January at 3,211,108 barrels a day.

Concerned over the state's production decrease in the face of rising imports, Texas Independent Producers & Royalty Owners Association has asked Standard Oil Company of New Jersey, Gulf Oil Corporation, The Texas Company, Shell Oil Company, Socony-Vacuum Oil Company, and Standard Oil Company of California to report their petroleum import plans for 1953.

If the major importers comply with these requests February 18, Texas oil interests, both major companies and independent concerns, will benefit. At least, it will be another step toward an understanding that will lead to a long-hoped-for "middle ground" wherein both importers and domestic producers can develop in the best interests of national welfare.

Tidelands Snag?

While the tidelands controversy is due to come up before Congress for settlement, favoring prompt passage of legislation giving the states clear title to their submerged lands, there are signs of a possible snag over just how far to sea the state boundaries should be fixed. Many advocates of state ownership favor the three-mile limit for states other than Texas and Florida (which claim 10½ miles) as well as 37½ percent of oil and gas revenues beyond those limits. There's a question whether Eisenhower would sign a measure with this percentage provision, but a compromise is expected, with settlement of the controversy due this spring.

Report from the Observatory

Reduced Crude Runs Needed

THE need for immediate reduction in crude runs to stills and possibly for lowered crude production in the near future were apparent from steadily rising stocks at January's end.

Refinery runs swelled to 7,221,000 barrels per day on January 7, after which they tapered off to a mid-month figure of 7,081,000, which is still much higher than the trends in demand require. The result has been a pile-up of distillate and residual fuels in some areas, particularly on the West and East coasts. The first price cut in some months for residual fuel was announced recently on the East Coast.

A breakdown of distillate stocks by areas shows that only the Gulf Coast has less on hand than a year ago, being 4.1 percent off the 1952 level. This indicates that stocks from this locality have been moved into the East Coast area, where fuels in this category are 20.9 percent above the year-ago level. Biggest accumulation is in California, where stocks have risen to an unhealthy 61.9 percent above the 1952 level.

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THE SAME RELATIVE situation holds as concerns residual stocks. The East Coast supply is 17.5 percent above a year ago and California has 40.9 percent more than a year ago. Biggest minus area, compared to a year ago, is in the Mid-Continent, where there has been a greatly intensified demand for this fuel, partly because many utility companies have converted to residual from coal.

In contrast to the U. S.-wide gain in residual and distillate stocks, gasoline inventories are at a finely balanced level of only 1.7 percent above a year ago. Yet, although prices remain firm for this product, continuation of the present rate of refinery runs would cause stocks to become burdensome before the end of winter and the beginning of the motoring season in April.

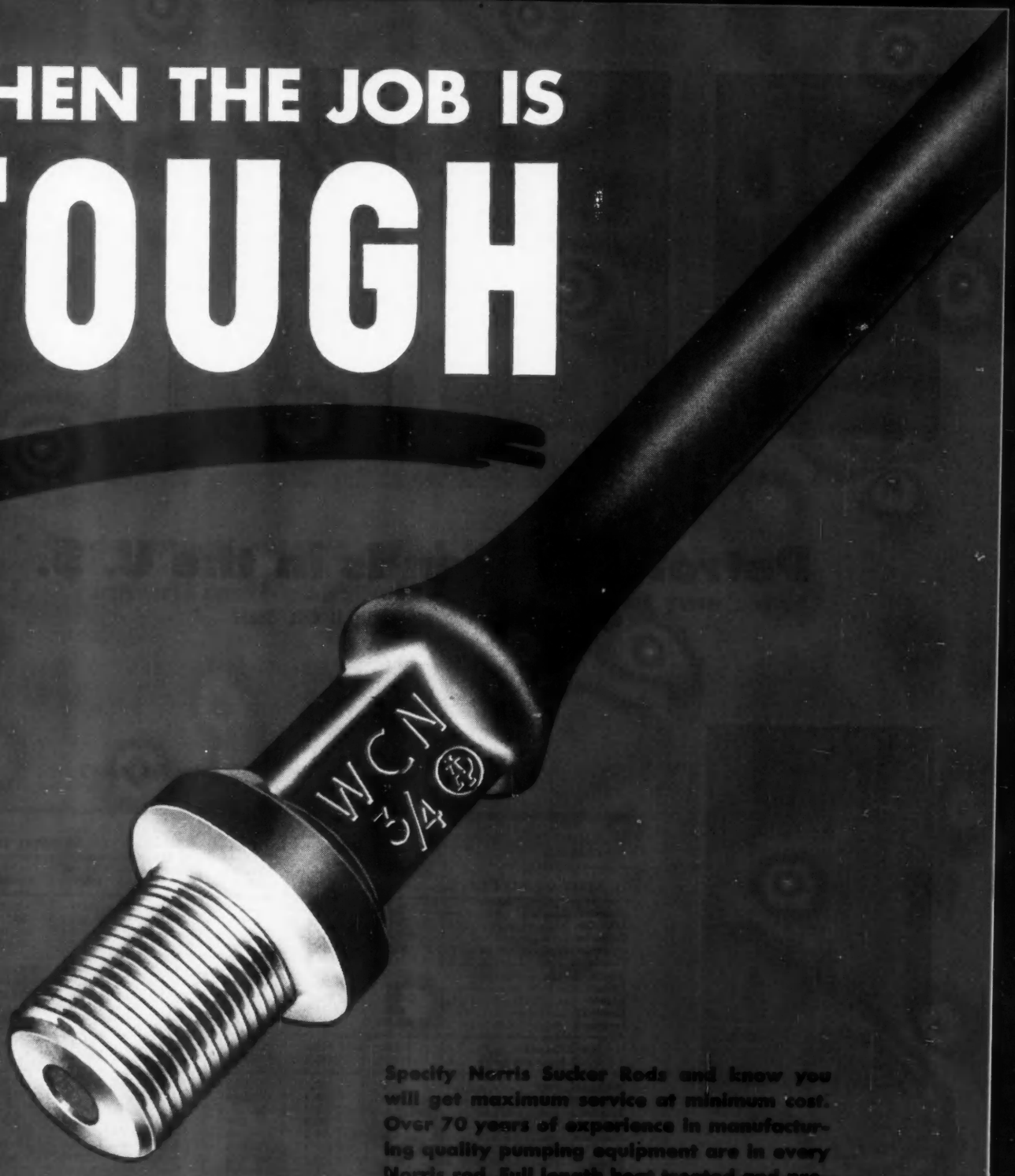
The whole answer does not rest in a slow-down of crude runs to stills. Reduced runs, combined with the high rate of crude production plus the present level of imports would cause additions to crude stocks, which are already more than 5 percent higher than a year ago. Moreover, higher crude production allowables for February, set by the Texas Railroad Commission, will not improve the crude supply situation. It is possible that by February's end crude stocks may well total 275 million barrels.

The whole situation points up to agitation for a drop in crude imports from the 1952 level of 577,000 barrels per day. But even with this reduction, the rapid rise in reserve producing and refining capacities during 1952, coupled with the further increases this year may bring about a situation of over-supply. Thus, there are reasons to believe that products prices may average lower than in 1952.

• • •

RECENT STUDIES have aroused considerable conjecture as to the present level of inventories had not the oil strike been called last year. Certain it is that the strike had little effect in reducing the supply of crude and products for the 12-month period. Crude supplies, for instance, were 9.2 percent above the 1951 period when the strike was called in April. At the end of the strike in May stocks were 16.1 percent above the year-before period but at the end of 1952 they were 4.8 percent above the figure for the previous year. Gasoline stocks shrank 12.5 percent below the previous year's period at the end of the strike; distillate stocks were off 13.1 percent; and residual inventories were 3.2 percent below the previous year's level. Yet at year's end there was 1.7 percent more gasoline, 15.5 percent more distillate and 11.2 percent more residual than at the end of 1951.

WHEN THE JOB IS TOUGH



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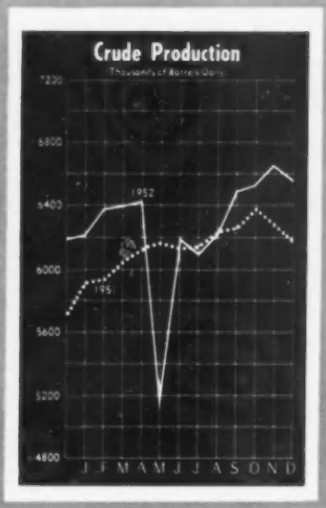
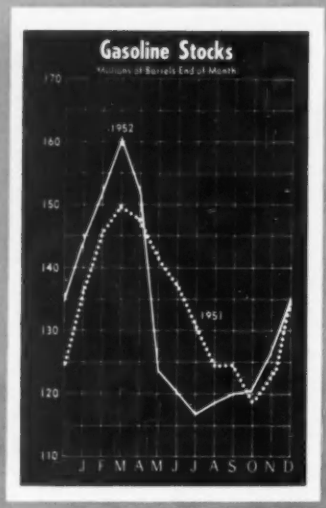
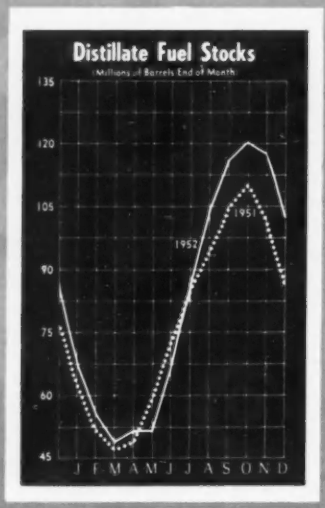
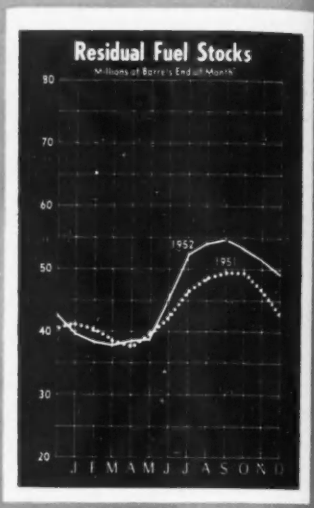


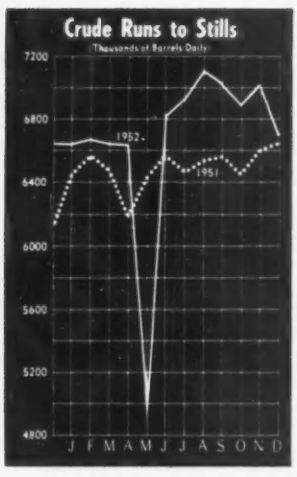


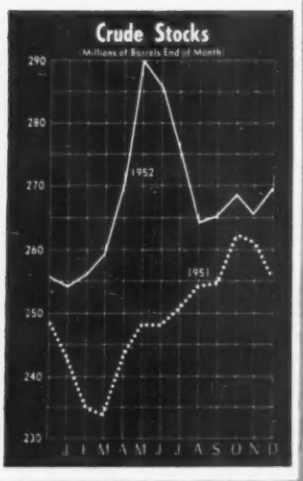




Petroleum Trends in the U. S.

By **CECIL W. SMITH**, WORLD OIL Staff

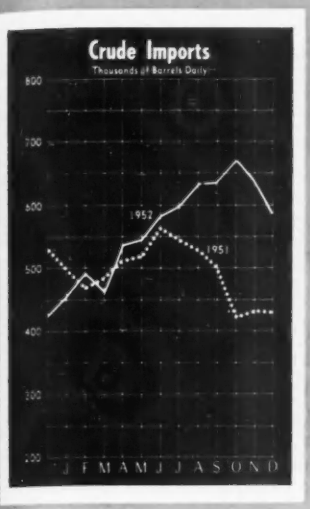


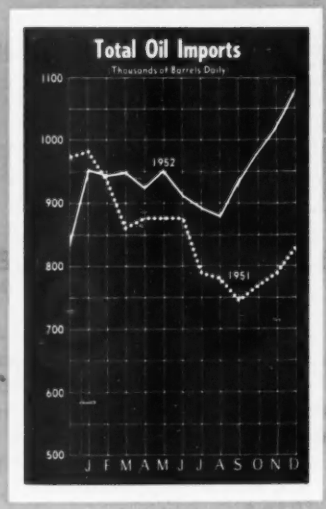


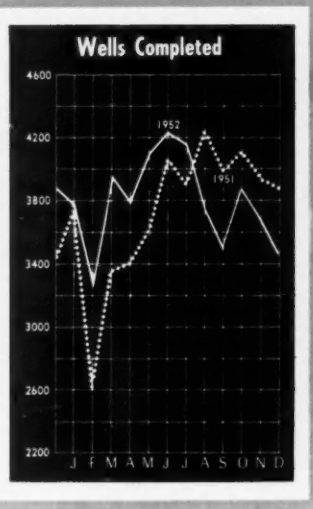
U. S. Crude Production by States

(THOUSANDS OF BARRELS)

STATE OR DISTRICT	DAILY AVERAGE PRODUCTION				TOTAL YEAR		
	December, 1952	November, 1952	December, 1951	% Diff. December, '51-'52	1952	1951	% Diff. '51-'52
Alabama	3.5	3.2	2.8	+25.0	972	1,020	— 4.7
Arkansas	76.9	76.4	80.8	— 4.8	29,229	29,770	— 1.8
California	990.5	984.4	977.5	—98.7	359,346	354,467	+ 1.4
Colorado	88.8	88.4	76.2	+16.5	29,436	27,225	+ 8.1
Florida	1.5	1.5	1.7	—11.8	592	596	— 0.7
Illinois	170.4	166.2	150.4	+13.3	58,969	58,207	+ 1.3
Indiana	33.3	33.7	29.9	+11.4	12,045	10,597	+13.7
Kansas	309.9	340.7	313.8	— 1.3	114,614	115,218	— 0.5
Kentucky	30.9	31.2	33.8	— 8.6	12,070	11,622	+ 3.9
Louisiana	685.6	677.9	638.4	+ 7.4	241,088	231,838	+ 4.0
North Louisiana	113.5	112.4	117.6	— 3.5	42,321	43,082	— 1.8
South Louisiana	572.1	565.5	520.8	+ 9.9	198,767	188,756	+ 5.3
Michigan	34.5	37.1	35.2	— 2.0	13,298	13,923	— 4.5
Mississippi	95.9	95.5	100.0	— 4.1	36,011	37,039	— 2.8
Missouri	.....	0.1	.....	.....	22	29	—24.1
Montana	29.9	29.2	23.0	+30.0	9,549	8,922	+ 7.0
Nebraska	8.9	8.6	5.5	+61.8	2,413	2,408	+ 0.2
New Mexico	173.6	171.2	150.9	+15.0	58,936	53,082	+11.0
New York	13.0	13.0	11.0	+18.2	4,382	4,254	+ 3.0
North Dakota	10.2	9.6	0.1	.....	1,503	22	.....
Ohio	9.0	9.0	6.8	+32.4	3,222	3,097	+ 4.0
Oklahoma	537.9	534.8	524.9	+ 2.5	192,252	187,789	+ 2.4
Pennsylvania	28.0	27.3	24.8	+12.9	11,072	11,150	— 0.7
Tennessee	.....	.....	.....	.....	9	14	—35.7
Texas	3,006.6	3,088.8	2,804.6	+ 7.2	1,030,350	1,010,128	+ 2.0
Dist. 1—South Central	38.8	39.3	32.9	+17.9	12,595	12,171	+ 3.5
Dist. 2—Middle Gulf	174.3	179.2	166.3	+ 4.8	59,118	60,156	— 1.7
Dist. 3—Upper Gulf	509.4	519.3	485.9	+ 4.8	175,076	180,401	— 3.0
Dist. 4—Lower Gulf-S. W.	273.0	280.6	256.3	+ 6.5	95,229	93,711	+ 1.6
Dist. 5—East Central	55.1	54.3	52.8	+ 4.4	19,906	19,190	+ 3.7
Dist. 6—Northeast	402.6	394.4	395.1	+ 1.9	142,987	142,706	+ 0.2
Dist. 7-B—North Central	113.0	118.4	84.3	+40.0	33,291	30,221	+16.8
Dist. 7-C—West Central	175.5	184.0	123.1	+42.6	55,109	38,530	+43.0
Dist. 8—West	989.2	1,046.8	956.8	+ 3.4	346,969	343,645	+ 1.0
Dist. 9—North	190.0	191.7	158.1	+20.2	61,946	56,894	+ 8.9
Dist. 10—Panhandle	80.7	80.8	83.5	— 3.4	29,927	31,783	— 5.8
Utah	5.2	5.1	4.9	+ 6.1	1,736	1,425	+21.8
Virginia	0.1	0.1	.....	.....	15	12	+25.0
West Virginia	6.7	6.9	6.8	— 1.5	2,574	2,743	— 6.2
Wyoming	206.9	193.1	178.3	+16.0	68,311	67,932	+ 0.6
Total United States	6,577.7	6,633.0	6,182.2	+ 6.1	2,294,016	2,244,529	+ 2.2





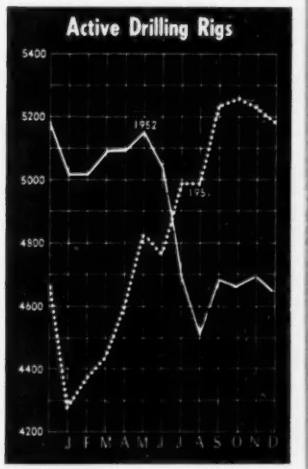


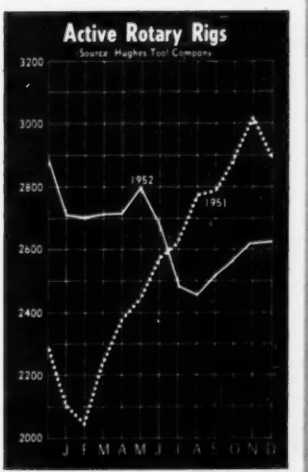
- **Crude output, refining cut**
- **Oil imports reach peak**
- **Heavy drafts on fuel oils**
- **Drilling cut at year's end**

Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL		DAILY IMPORTS	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Crude Oil	Total Oils
1950:											
October	5,900	6,077	246,424	2,875	105,764	1,217	85,643	1,250	45,004	510	896
November	5,891	6,085	250,016	2,859	109,005	1,218	86,113	1,240	45,048	466	891
December	5,719	6,143	248,463	2,879	116,769	1,343	71,948	1,306	40,750	530	974
1951:											
January	5,907	6,450	243,107	2,962	136,145	1,427	62,163	1,368	41,251	499	977
February	5,930	6,562	235,247	2,906	145,184	1,419	51,348	1,382	40,716	468	937
March	6,052	6,469	233,824	2,908	149,679	1,327	46,744	1,348	38,366	483	861
April	6,127	6,183	243,180	2,821	147,679	1,171	48,239	1,230	37,623	511	871
May	6,170	6,436	248,418	3,031	141,658	1,210	59,272	1,265	39,879	518	876
June	6,130	6,575	248,170	3,100	137,009	1,254	72,140	1,277	42,398	563	876
July	6,141	6,462	250,847	3,091	130,931	1,228	84,282	1,275	46,320	546	788
August	6,232	6,539	254,276	3,114	124,202	1,237	94,028	1,226	48,365	529	780
September	6,261	6,558	254,900	3,127	124,530	1,282	104,082	1,228	49,608	500	744
October	6,375	6,446	262,266	3,105	118,864	1,295	109,544	1,224	49,573	421	769
November	6,272	6,609	261,100	3,130	122,723	1,358	101,666	1,304	46,491	425	802
December	6,182	6,646	255,783	3,150	134,867	1,442	86,619	1,313	42,853	423	834
1952:											
January	6,217	6,640	254,007	3,094	144,339	1,456	66,969	1,338	39,523	488	951
February	6,367	6,673	255,900	3,109	151,912	1,528	55,369	1,322	38,295	491	940
March	6,388	6,640	259,126	3,069	160,689	1,400	48,750	1,274	37,971	510	947
April	6,429	6,435	270,679	2,995	151,890	1,312	51,634	1,253	38,561	539	922
May	5,107	4,905	290,813	2,295	123,656	982	51,648	979	38,821	545	951
June	6,197	6,825	285,964	3,169	120,166	1,455	65,911	1,228	45,688	581	911
July	6,093	6,927	275,951	3,295	116,566	1,475	85,775	1,237	52,245	597	892
August	6,219	7,118	264,368	3,377	118,592	1,514	104,257	1,252	54,061	632	879
September	6,518	7,017	264,723	3,428	120,991	1,502	117,252	1,230	56,200	615	932
October	6,518	6,883	269,776	3,301	120,062	1,458	120,721	1,203	53,052	643	1,038
November	6,633	7,031	265,885	3,404	127,210	1,531	117,472	1,248	52,152	637	1,022
December	6,558	6,667	268,465	3,377	135,906	1,514	101,843	1,282	49,117	580	1,085
Dec., 1952 Change:											
In Month	−75	−364	+2,580	−27	+8,696	−17	−15,629	+34	−3,035	−57	+63
In Year	+376	+21	+12,682	+227	+1,039	+72	+15,224	−31	+6,264	+157	+251
Week Ended:											
1-10-53	6,468	7,117	267,878	3,395	140,674	1,569	95,006	1,336	48,876	730	1,305
1-12-52	6,178	6,625	253,616	3,159	138,380	1,413	81,442	1,369	42,268	448	880





News Analysis

Moves Begun to Limit Natural Gas Output to Market Demand

Legislation is being promoted in Oklahoma and other gas producing states, proposing that the states may limit output of natural gas to market demand. Such restriction already is applied to crude oil. In Oklahoma it is proposed, further, that legislation be passed to require local underground storage of any gas produced in excess of the officially determined current market demand. This proposal would prevent production of natural gas for transportation to distant states for the purpose of storing it underground and not using it currently.

As in the case of early oil proration laws, these proposed laws for natural gas conservation raise questions of their constitutionality and their possible invalidity because of interfering with interstate commerce. Nevertheless, now that the natural gas industry is "growing up" and increasingly concerned with gas conservation, new state laws and regulations affecting gas appear inevitable.

This subject was brought into the spotlight January 6 in the message delivered by Governor Murray to the 24th Oklahoma Legislature.

The governor praised Oklahoma and other states for conservation of oil by limiting production to market demand, but deplored the failure to exercise similar control over natural gas resources.

"In view of the growing demand for this product (natural gas) and the probable limitations of the supply locally available," he declared, "it is high time that we begin to give serious consideration to the future of natural gas conservation."

1951 Law. In 1951 Oklahoma passed a law providing for conservation of natural gas and granting the right of eminent domain to any natural gas utility desiring to secure property for underground storage purposes. That was a forward step, said Murray, but did not go far enough. Gas fields in the Mid-Continent and elsewhere are producing more natural gas than is immediately required for the market demands and the true needs of the areas being served, he said. Much of this surplus gas is being transported to the East and North and there stored under pressure in abandoned mine shafts, caves and depleted oil sands.

"This gas is thus forever removed from Oklahoma," Murray told the legislators, "and made unavailable to local future market demands. More than that, it is taken out of the hands of the local producers and placed elsewhere, thus depriving the local producer of the benefit of the upward market trend most likely to come as the demand for the use of natural gas becomes greater in the presently foreseeable future. All of the types of facilities now being used elsewhere for the storage of natural gas are available in Oklahoma and might well be utilized for such purpose."

It will be possible to determine market demand for natural gas by methods already used in regulating oil production, Murray stated. In many cases, he said, in order to produce the oil necessary to meet the market demand, it is necessary to produce more gas than available market facilities can handle, and much of this has been wasted into the air.

Action Urged. Murray proposed that the Oklahoma legislature give immediate attention to legislation that will require a determination of the immediate market demand for natural gas from month to month, and instead of permitting an excess to be transported beyond the confines of the state, to require that the surplus gas be stored and kept within the state, producing from such reserves, from time to time, such amounts as may be needed to complete the market demand. He proposed also to draw from such storage gas required for repressuring and secondary recovery and to keep in storage all of the reserves not immediately needed so that the gas supply will be available primarily to meet the demand of Oklahoma consumers, and particularly to meet the demands of —and as an inducement to—new industries.

"In entering into this field of operation, in addition to all of the resultant benefits flowing from the conservation of this invaluable resource, we will, in effect, create a new industry, that of providing and maintaining facilities for storage purposes. It will furnish employment, it will fix some value on the old and depleted oil sands in the state and provide a new source of income to the owners thereof.

"This subject has received serious discussion and consideration at many of the recent meetings of the Interstate Oil Compact Commission," Governor Murray said, "and the time is ripe for action in this regard. I urgently recommend that you (Oklahoma legislators) confer with the legislators and regulatory bodies of some of the other oil-producing states in the hope that the type of legislation here proposed can be made uniform. In some of the states it will be found that very little legislation is necessary to do this, and in some, perhaps, none at all, due to the fact that the regulatory bodies are already clothed with sufficient authority; but in all events, cooperation will come when the benefits of this type of conservation are made perceptible. I recommend that this action in Oklahoma be taken without delay."

Price Inquiry?

Iowa Senator Gillette, a Democrat, is leading a renewed fight to create a Select Committee on Consumer Interest which would investigate prices charged the ultimate consumer for food, fuel and clothing as well as the costs and methods of producing, processing and distributing these and other consumer goods.

This time, the Iowan has joined with 25 others in the Senate to have this committee set up. Success of the fight is in doubt however. The newly-introduced legislation is identical with the bill Gillette put before the 82nd Congress and which received no floor action.

Lane-Wells Company

Letter to a Skeptic

Dear Tom:

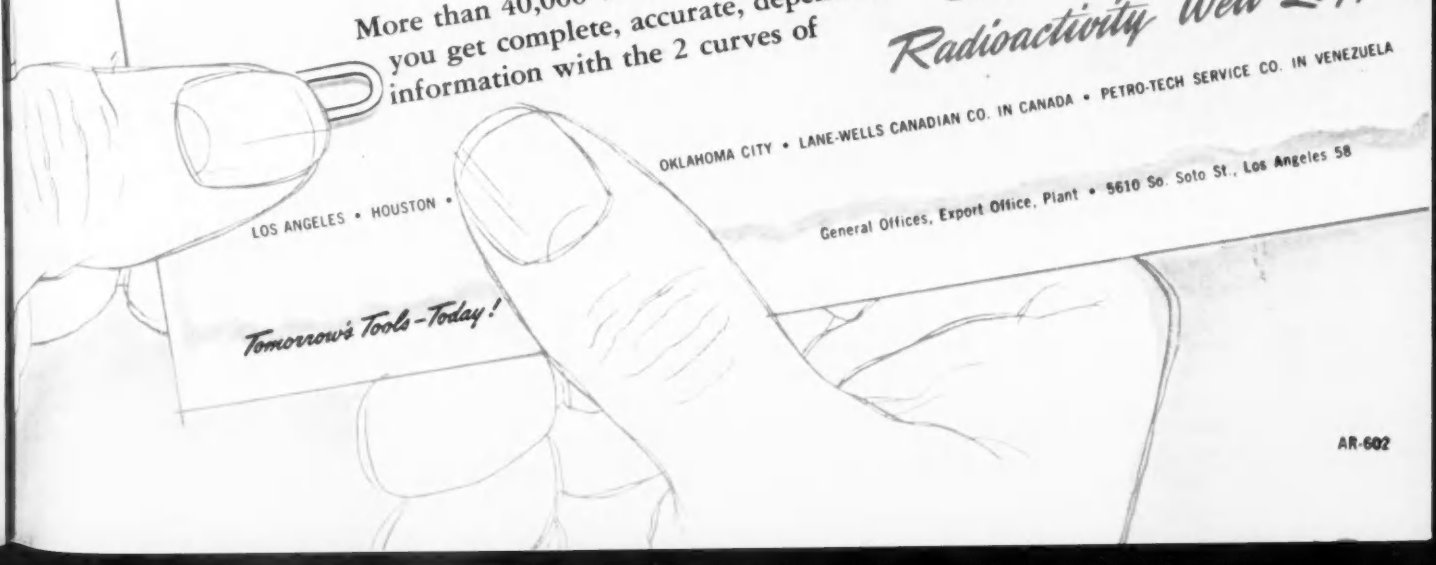
Is that the way to do a friend -- challenge his statements, and then duck out before he can prove them? Sure, I know you were called away, this afternoon, but you asked me to prove the value of Lane-Wells Radioactivity Well Logging, and by gosh, I'm going to do it!

You agreed that Radioactivity Well Logging worked in both open hole and cased hole, and that the Neutron Curve indicated the fluid-bearing zones in the formations defined by the Gamma Ray Curve. But you got away before I could get across the important point that in Lane-Wells Logging both these curves have high repeatability -- which means reliability; you can depend on their information. There are plenty of logs in our files that prove it; we'll show you some that have been released, any time you like.

You agreed also that the casing collar log was a valuable guide for all future work in the well -- I just want to emphasize that a great part of that value lies in Lane-Wells accurate depth measurements. You know that's true.

But the one big thing to keep in mind is Lane-Wells experience in Radioactivity Well Logging -- more than 43,000 logs in over 3,200 fields! We recognize the dozens of local variations. In some fields we can give you quantitative interpretation to tell 'how much' and 'where'. In short, we can help you know the underlying structure of the oil country as well as you know the surface.

This ad clipping sums up the whole story.



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AR-602

'Cartel' and Tidelands Issues High on Eisenhower Agenda

Out of the general anti-business atmosphere that has hung over Washington for the past 20 years and which was stirred to a storm-cloud peak in the dying days of Democratic Party rule, industry leaders—petroleum officials in particular—look to the Eisenhower administration to clear the way for sound business operations.

A few strokes of Former President Truman's pen at the eleventh hour made oil industry problems requiring President Eisenhower's immediate attention more critical. President Eisenhower had until January 28 to act to prevent the broad expose of a mass of documents covering international petroleum operations for a number of past years, the release of which Truman's top State and Defense Department advisors have said would seriously damage national security and interest.

The documents, representing Exhibit A in the six-month-old unproven charges by the former Truman administration that five American oil companies and their subsidiaries operated in an international "cartel," were ordered presented by the companies to a federal grand jury by that date.

Deal Rejected. The final participation by Truman in the criminal court proceedings against the companies was an unsuccessful attempt to strike a "deal" with the oil companies to drop the criminal suit and substitute civil action. Such an offer was flatly rejected by the oil companies on the grounds that in either type suit the documents requested ordered by the government from the companies would be made public.

In postponing the grand jury proceedings until after the Eisenhower administration took office, Presiding Federal Judge James Kirkland summed the indecision in the suit with the observation that there is an "apparent lack of harmony among the executive branches" of the Democratic administration.

Three days after his action in the cartel case, termed as an attempt at "blackmail" by a leading defense attorney, Truman by executive decree transferred tidelands oil reserves to the Navy to be established as a fifth Naval Petroleum Reserve. He commented that the potential oil reserves in the submerged coastal waters were needed for national defense and not for "oil interests."

Two Bills Introduced. The action by Truman left the decision to return the disputed tidelands area back to the coastal states, where petroleum development has lagged since the original 1947 Supreme Court ruling that the federal government had "paramount rights" in the area, either to President Eisenhower, who has the power to set aside the executive order, or to Congress. Two quit-claim bills returning tidelands ownership to the states have been introduced.

Florida Democratic Senator Holland introduced one bill with the support of 49 senators, 24 Republicans and 25 Democrats. This bill was passed by both Houses of the previous Congress and was vetoed by Truman. It would have given the states clear title to all lands beneath the navigable waters within their boundaries, including any minerals or natural resources. The limit of jurisdiction for most states would be three miles below the low water mark along the sea coast. In the case of Texas and Florida, the state control would extend for three marine leagues offshore, or 10½ miles.

Another bill, by Texas Senator Daniel, contains the same provisions as the Holland bill, and, in addition, would declare for the first time that the Federal Government's jurisdiction extended from the states' areas of jurisdiction out to the limits of the continental shelf, which is upwards to 200 miles offshore in some points.

Royalty Cut. In the area of federal ownership, or public domain, between the states' offshore boundaries and the end of the continental shelf, the Daniel bill would give the states authority over leasing in the new public domain lands with the states retaining 37½ percent of royalties derived from operations, the remaining 62½ percent of royalties going to the U. S. Treasury to be applied to the principal on the public debt.

In effect, the Daniel bill in establishing a public domain in the offshore areas beyond the states' submerged waters boundaries would establish the same plan now in effect in onshore federal lands where the states receive 37½ percent of royalty proceeds from federal lands within their boundaries.

Plan Would Hike Tax on Tank Trucks

Owners of oil-hauling tank trucks would pay higher taxes under the plan advanced recently in Washington by an Ohio highway engineer. D. F. Pancoast, Ohio Department of Highways staff engineer, called for an increase in truckers' share of the cost connected with the building and maintaining of highways. And he would lessen the tax load now on automobile owners.

In arguing his case, Pancoast told the Highway Research Board that a study shows that the heaviest trucks and trailers are responsible for almost 100 times as much wear and tear on highways as passenger cars. He used these figures as a base for his suggestion that taxes on vehicles be based on axle miles, instead of ton-miles or vehicle miles.

Contending that his program could raise money for modernizing crumbling highway systems and permit reduction in passenger car taxes, Pancoast told the board that Ohio State could get more than $200 million annually from its motor vehicle owners at an average cost of $40 to private motorists. The registration fee, property tax and gasoline taxes paid by medium sedan owners in the U. S. are now averaging slightly more than $72 a year.

Profit Problem

Use of government tax money again has been urged by the Interior Department to bridge the gap between government and private commercial synthetic liquid fuels plant operation.

In an Interior Department report to Congress pointing to technical advances which had been made in government experimentation plants and to Bureau of Mines estimates that indicate coal hydrogenation and oil shale plants could be operated at a profit, a fly in the ointment appeared: Secretary Chapman realizes that initial plants may not be profitable enough to attract the required capital without government help.

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Need something small in drop forgings? Or do your present needs call for a forging that runs to weight—say a couple of hundred pounds or more?

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Keep our name handy, won't you? Think Bethlehem and call Bethlehem for a good job of forging—a job planned right, done right.

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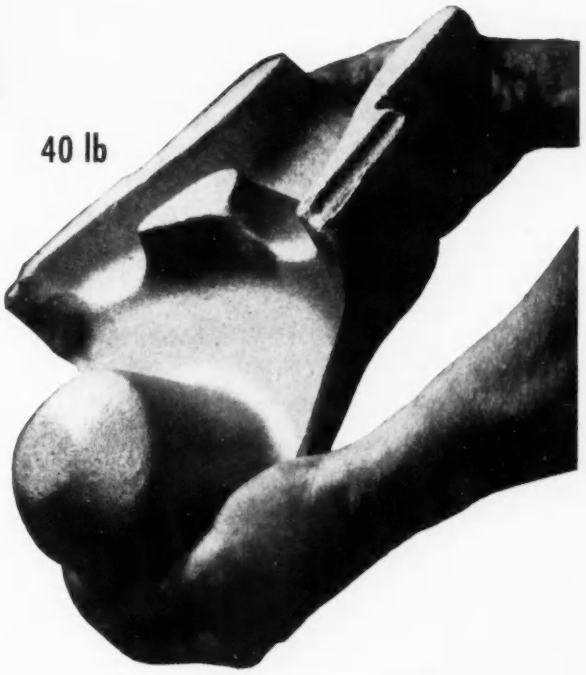

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Full die-sinking equipment
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BETHLEHEM DROP FORGINGS

1952 Footage Sets Record, Completions Near Peak

THE U. S. petroleum industry completed the second greatest number of wells in its history and drilled more footage than ever before in 1952.

Wells completed total 46,412, which was only 354 fewer, or .8 percent less than the record year of 1951. More indicative of the year's tremendous activity was total footage, which rose 5.3 percent to 186,867,619 in 1952, compared with 177,420,734 the year before.

Each new well drilled in 1952 averaged 4062 feet, compared with 3843 in 1951 and 3689 the year before that.

The decline in total new wells for the year was paralleled by fewer completions in the two biggest oil-producing states, Texas and California. Texas had 3 percent fewer wells compared with the record-breaking year before, though it had 3,472,230 more footage. California's new well activity was almost the same, having been only .1 percent off the previous year's pace, and here again there was an increase in footage.

Texas' decline in new wells, totaling 551, more than accounted for the nation's drop in completions, and one area more than accounted for Texas' drop in wells drilled. This was the Spraberry area, District 8 (West Texas), which had 725 fewer wells than the previous year and 3,487,490 less footage.

Best gain in Texas was registered by District 7-C (West Central), which had a 30.3 percent increase in new wells drilled and a footage gain of 4,280,977.

There was a notable slackoff in completions in the Illinois Basin, where Illinois had 12.7 percent fewer new wells, Indiana 1.7 percent, Kentucky 16.4 percent and Michigan 7.2 percent.

Louisiana with 5.9 percent and Oklahoma with 3.6 percent registered gains in the new completions column.

Most prominent gainer of all was North Dakota, a Williston Basin state, which had 96 completions in 1952 and only 10 in 1951 for an increase of 860 percent.

Wells Completed in the United States During December, and Twelve Months, 1953

State or District	MONTHLY COMPLETIONS, DECEMBER, 1952									TOTAL COMPLETIONS				CUMULATIVE TOTALS January-December					Rigs in Operation (Drilling, Rigging-Up and Shut Down)		
	NEW WELLS																				
	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	Dec., 1952	Nov., 1952	Dec., 1951	Footage Dec., 1952	Wells 1952	Wells 1951	Percent Diff.	Footage 1952	Footage 1951	Dec. 31, 1952	Nov. 30, 1952	Dec. 31, 1951
Alabama	4			7				11		11	8	4	65,595	75	55	+ 36.4	457,085	278,167	9	6	4
Arizona														2	4	— 50.0	10,755	8,635	4	2	2
Arkansas	15		1	22				38		38	39	40	148,013	436	432	+ 0.9	1,618,191	1,509,961	28	36	33
California	141			50			1	192	3	195	207	203	834,672	2,517	2,519	— 0.1	10,554,610	9,688,129	260	253	274
Colorado	7		3	30				40		40	53	43	211,510	485	307	+ 58.0	2,576,748	1,506,727	46	40	41
Florida				2				2		2		1	10,406	9	4	+125.0	55,813	22,109	1	3	1
Georgia																			1		
Idaho														1		—100.0		12,844	1	3	1
Illinois	49			69				118	1	119	236	210	317,237	2,091	2,396	— 12.7	5,194,647	6,046,374	181	192	189
Indiana	37		1	60				98		98	174	103	185,854	1,349	1,372	— 1.7	2,418,706	2,491,868	185	179	172
Kansas	106		25	153			2	286		286	307	414	994,672	4,182	4,319	— 3.2	14,511,612	14,854,565	444	442	389
Kentucky	35		15	61				111		111	103	138	223,219	1,423	1,701	— 16.4	2,743,044	3,297,822	86	111	87
Louisiana	86	7	26	84				203		203	214	190	1,339,935	2,406	2,273	+ 5.9	15,877,668	14,482,102	236	237	238
North Louisiana	43	2	13	37				95		95	124	87	353,405	1,317	1,263	+ 4.3	5,037,560	4,869,818	57	56	78
South Louisiana	43	5	13	47				108		108	90	103	986,530	1,089	1,010	+ 7.8	10,840,108	9,612,284	179	181	160
Maryland											2	7		34	44	— 22.7	136,053	184,738	5	4	25
Michigan	23		3	36				62		62	42	47	168,861	649	699	— 7.2	1,749,465	1,775,772	80	88	115
Mississippi	7	1		25				33		33	29	43	236,564	346	395	— 12.4	2,492,239	2,623,941	35	38	37
Missouri				1				1		1		7	510	31	11	+181.8	30,702	8,747	3	4	3
Montana	16		3	24				43		43	36	20	176,192	326	278	+ 17.3	1,156,562	674,615	57	61	39
Nebraska	6		2	12				20		20	15	20	107,091	248	240	+ 3.3	1,242,294	1,048,407	20	16	17
Nevada				1				1		1			11,543	1	2	— 50.0	11,543	15,431	1		1
New Mexico	39		18	14				71	1	72	89	85	450,907	1,091	733	+ 48.8	6,059,086	3,670,872	189	178	177
New York	51				32			83		83	88	49	114,397	1,077	933	+ 15.4	1,494,239	1,369,214	106	108	58
North Carolina															3	—100.0		8,006			
North Dakota	11			7				18		18	18	1	148,237	96	10	+860.0	805,049	50,306	33	33	10
Ohio	26		15	27				68		68	108	62	157,973	995	916	+ 8.6	2,136,950	1,877,434	166	163	146
Oklahoma	283	2	27	197	2			511	10	521	458	441	1,910,867	5,822	5,622	+ 3.6	21,534,094	20,328,787	619	595	651
Oregon															3	—100.0		13,216			
Pennsylvania	49		19	7	43	8		126	2	128	146	111	217,280	1,700	1,780	— 4.5	2,874,254	3,459,891	227	250	240
South Carolina															1	—100.0		995			
South Dakota				2				2		2		1	5,423	7	3	+133.3	25,954	8,083	2	3	3
Tennessee														40	41	— 2.4	49,600	43,000	5	5	7
Texas	644	16	47	505	5			1,217	8	1,225	1,283	1,571	5,711,699	17,635	18,186	— 3.0	83,500,066	80,027,836	1,325	1,345	1,899
Dist. 1: S. Central	32		1	31	1			65		65	51	58	204,487	780	642	+ 21.5	2,313,624	1,773,037	39	35	43
Dist. 2: Middle Gulf	17	4	2	31				54		54	78	86	333,946	819	810	+ 1.1	5,188,009	4,780,751	50	54	73
Dist. 3: Upper Gulf	54	6	5	53				118		118	140	146	806,508	1,756	1,552	+ 13.1	11,633,310	9,757,193	113	131	146
Dist. 4: L. Gulf-S.W.	61	6	18	44				129		129	120	139	759,046	1,615	1,723	— 6.3	8,663,050	8,601,370	113	104	107
Dist. 5: E. Central	6			18				24		24	19	36	104,230	347	479	— 27.6	1,715,185	2,039,183	18	17	27
Dist. 6: Northeast	9		5	21				35		35	30	52	208,743	508	687	— 26.1	3,108,547	3,578,988	37	43	53
Dist. 7-B: N. Cent.	106		3	99				208	1	209	244	269	665,359	2,751	2,832	— 2.9	8,595,559	8,234,899	140	143	188
Dist. 7-C: W. Cent	67			37				104	1	105	124	173	566,184	2,035	1,562	+ 30.3	11,745,082	7,464,105	133	141	265
Dist. 8: West	138		1	49	1			189	5	194	201	296	1,067,084	3,291	4,016	— 18.1	18,425,334	21,912,824	327	335	568
Dist. 9: North	129		3	121	3			256	1	257	241	260	891,074	3,171	3,001	+ 5.7	10,327,799	9,058,115	280	267	299
Dist. 10: Panhandle	25		9	1				35		35	35	56	105,038	562	882	— 36.3	1,784,567	2,827,371	75	75	130
Utah	3			2				5		5	8	3	33,124	79	37	+113.5	502,005	180,708	29	29	29
Virginia															28	—100.0		132,365			1
Washington												1			1	—100.0		3,711			1
West Virginia	8		38	9				55		55	45	40	132,888	587	643	— 8.7	1,697,488	1,822,244	185	182	208
Iowa															3	—100.0		6,232			
Wyoming	30		4	30				64	1	65	69	79	325,373	673	771	— 12.7	3,351,097	3,886,880	80	83	84
Total U.S.	1,676	26	247	1,437	82	8	3	3,479	26	3,505	3,777	3,934	14,240,042	46,412	46,766	— 0.8	186,867,619	177,420,734	4,649	4,689	5,182

It's the end result that tells the profit story!

Argo Oil Corporation Increases Stock Tank Recovery Over 50% During 2-Month Test Period

Argo's South Texas installation... BS&B Glycol Injection System of Low Temperature Separation with Stabilizer. This equipment is paying off at the stock tank... is recovering more condensate... is saving products formerly wasted.

. . . and here's the end result!

Portable Separator Unit test showed stock tank recovery was 19.75 barrels per MMSCFD of sales gas. The 1st stage separator was operated at 800 p. s. i. at 70° F.

But look what happened when the BS&B Glycol Injection System with Stabilizer was installed

OPERATIONAL DATA:

Inlet flowing conditions	2250 p. s. i. @ 120° F.
Flow rate	5.1 MMSCFD
Separator pressure	940 p. s. i.
Separator temperature	10° F.
Water content of sales gas	2.3 lbs. per million
Vapor pressure stock tank oil	14 p. s. i. (RVP)
Stock tank recovery	31.03 Barrels per MMSCF of sales gas

Increased Recovery ***57%***

Increased Daily Revenue ***$161.06***

BS&B Glycol Injection System OF LOW TEMPERATURE SEPARATION with STABILIZER*

BS&B . . . for 60 years a leader in oil and gas producing and refining equipment...also manufacturers of Climax Controls, Safety Devices and special fabricated pressure vessels. Ask your BS&B Man. There's one of BS&B's 35 Branches or 17 Sales Offices near you if you're in the Oil Country, or write

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More U. S. Crude Needed in '53

• Higher demand to require domestic production increases of 1.1 percent for crude and 4.6 percent for natural gasoline.

• Forecast assumes no net change in stocks and import gains of 11.1 percent for crude and 5.3 percent for products.

• Total demand to be up 3.8 percent with domestic use 4.9 percent higher but exports 16.2 off.

TOTAL demand for all oils in 1953 will average 8 million barrels daily, an increase of 3.8 percent over 1952, according to the Bureau of Mines. The percentage increase forecast by the bureau is approximately in line with the average of leading oil company economists.

Domestic demand for 1953 is estimated at an average of 7,647,000 barrels per day, a gain of 4.9 percent over last year. The lower total demand figure results from the bureau's prediction that exports of crude oil and refined products this year will decline by 16.2 percent to an average of 353,000 barrels daily.

"The forecast of new supply required," the bureau stated, "shows a gain of only 2.3 percent, since supply was inflated in 1952 by a large increase in stocks and no further stock increases seem essential in 1953." A gain of about 8.8 percent in total imports is forecast for 1953, with the total for the year expected to reach a record high of 1,038,000 barrels a day. This would compare with an estimated average of 954,000 barrels daily in 1952. Daily average crude oil imports are estimated to increase by 11.1 percent in the year, and refined product imports are expected to show a rise of 5.3 percent.

Based on these expectations, the bureau predicted that daily average demand for domestic crude oil will show an increase of 1.9 percent. Demand for domestic crude in 1952 increased only an estimated 1 percent, according to bureau calculations. The forecast shows that demand for and production of domestic crude oil in 1953 will average 6,329,000 barrels daily and that production of natural gas liquids will average 633,000 daily, for a total production of 6,962,000 per day, or a gain of 1.4 percent over 1952.

In its annual review and forecast, the bureau estimated that total demand for petroleum in 1952 averaged 7,708,000 barrels daily, including exports of 421,000 barrels daily and a domestic demand of 7,287,000 barrels per day. Compared with 1951, total demand was 3.4 percent greater, exports declined 0.5 percent and domestic demand increased 3.6 percent.

The 3.8 percent increase predicted for daily average total demand in 1953 includes estimates of increases of 5.0 percent for motor fuel, 0.9 percent for residual fuel, 5.8 percent for distillate fuel, 2.8 percent for kerosine and 2.1 percent for other oils. The 4.9 percent gain in domestic demand includes forecasts of increases of 5.5 percent for motor fuel, 2.5 percent for residual, 7.7 percent for distillate, 4.4 percent for kerosine and 3.4 percent for other oils.

Sharp declines are forecast for the export market, with the total expected to average 353,000 barrels daily, a drop of 16.2 percent from 1952. Daily average crude oil exports are expected to show a decline of 14.3 percent, mostly due to Canadian production rises, and product exports are predicted to decrease by 16.5 percent.

U. S. Bureau of Mines 1953 Forecast of Supply and Demand

(MILLIONS OF BARRELS)

ITEM	Estimated 1952 Full Year	1953 FORECAST First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Total 1953	Percent Change in Daily Average, 1953 vs. 1952
Production, Total	2,513.5	634.0	622.0	634.0	651.0	2,541.0	+ 1.4
Crude Oil	2,292.0	576.0	566.0	577.0	591.0	2,310.0	+ 1.1
Other Oils	221.5	58.0	56.0	57.0	60.0	231.0	+ 4.6
Imports, Total	349.0	98.0	92.0	88.0	101.0	379.0	+ 8.8
Crude Oil	211.0	57.0	58.0	59.0	60.0	234.0	+11.1
Refined	138.0	41.0	34.0	29.0	41.0	145.0	+ 5.3
New Supply	2,862.5	732.0	714.0	722.0	752.0	2,920.0	+ 2.3
Change in Stocks	+41.5	—35.0	+29.0	+35.0	—29.0	.....	.....
Crude Oil	+21.0	.....	.....	.....	.....	.....	.....
Products	+20.5	—35.0	+29.0	+35.0	—29.0	.....	.....
Total Demand	2,821.0	767.0	685.0	687.0	781.0	2,920.0	+ 3.8
Motor Fuel	1,187.0	275.0	324.0	332.0	313.0	1,244.0	+ 5.0
Residual	581.0	166.0	136.0	126.0	157.0	585.0	+ 0.9
Distillate	514.0	184.0	101.0	93.0	164.0	542.0	+ 5.8
Kerosine	133.0	47.0	22.0	22.0	45.0	136.0	+ 2.8
All Other	406.0	95.0	102.0	114.0	102.0	413.0	+ 2.1
Exports, Total	154.0	35.0	35.0	31.0	28.0	129.0	—16.2
Crude Oil	25.5	6.0	6.0	5.0	5.0	22.0	—14.3
Refined	128.5	29.0	29.0	26.0	23.0	107.0	—16.5
Domestic Demand	2,667.0	732.0	650.0	656.0	753.0	2,791.0	+ 4.9
Motor Fuel	1,154.0	267.0	316.0	325.0	306.0	1,214.0	+ 5.5
Residual	552.0	160.0	130.0	121.0	153.0	564.0	+ 2.5
Distillate	482.0	178.0	94.0	87.0	159.0	518.0	+ 7.7
Kerosine	125.0	45.0	20.5	20.5	44.0	130.0	+ 4.4
All Other	354.0	82.0	89.5	102.5	91.0	365.0	+ 3.4
Daily Averages (Thousands of Barrels):							
Total Production	6,867	7,044	6,835	6,892	7,076	6,962	+ 1.4
Imports	954	1,089	1,011	956	1,098	1,038	+ 8.8
Change in Stocks	—113	—389	+319	+381	—315	.....	.....
Total Demand	7,708	8,522	7,527	7,476	8,489	8,000	+ 3.8
Exports	421	389	384	337	304	353	—16.2
Domestic Demand	7,287	8,133	7,143	7,130	8,185	7,647	+ 4.9
Runs to Stills	6,664	6,920	6,750	6,810	6,972	6,863	+ 3.0
Demand Domestic Crude	6,213	6,400	6,220	6,272	6,424	6,329	+ 1.9

Compensation Laws Under Fire

Drilling contractors fight higher insurance rates but agree that there must be fewer accidents and some remedial legislation in Texas.

By **AL REESE,** WORLD OIL Staff

DRILLING CONTRACTORS continued a two-pronged assault last month on one of the most drastic increases in workmen's compensation and employers' liability rates to be assessed in years against a major segment of the Texas oil industry.

One prong took the form of a battery of new statistics intended to show the Texas Board of Insurance Commissioners that the drilling industry does not deserve a 28.8 percent hike. This increase figures to cost the drilling contractors $1 million more in premiums this year than they believe to be justified.

The other prong digs at the roots of the high rate structure. It is a bill which, if passed by the Texas Legislature, will overhaul the procedure under which compensation is granted. This bill is a result of a cooperative effort on the part of an estimated 100,000 Texas employers who seek to eliminate abuses of the law and to assure legitimate claimants of prompt and adequate compensation benefits.

Thus, the contractors and insurance companies are in disagreement as to rates but strongly in accord as to a major reason they are so high.

The insurance companies were granted a 17.9 percent raise of all Texas compensation rates, effective December 1, after asking the Board of Insurance Commissioners for a 19.9 percent increase. The scarcity of subsequent protests indicated that most industries, oil and otherwise, were resigned to the new rates; but the drilling contractors filed an opposing brief in November and again in December through Joseph M. Shelton, Dallas attorney, who was assembling still more arguments last month.

The insurance companies' weightily statistical plea for the big increase was pointed up by the fact that the cost of settling each compensation claim in all industries rose to $182.39 in 1952 from $126.36 in 1948.

Most striking argument in the contractors' rebuttal stemmed from the Board of Insurance Commissioners' Circular Letter No. 239, issued in February, 1952, which raised the limitation on weekly payrolls used for premium computation purposes from $100 to $200. At a rate of $10.05 per $100 of payroll, as set by the Board in November, this would expose about 10 percent more of the drilling industry's payroll to premium calculations. The contractors admit the carriers are entitled to some increase, but proposed a manual rate of $9.33, which would have entailed a payment of $9½ million in premiums instead of the $10½ million it will pay under the new rates, according to Shelton.

Net Cost

(Because of the method of adjusting insurance rates with credits or debits according to losses incurred, the net cost to each assured will not necessarily be in proportion to the over-all increase. The contractor with many rigs and a sound safety program will accumulate credits which will be reflected in a lower net insurance cost than the average for the industry.)

At its October hearing the Board took cognizance of an additional exposure of all Texas industrial payrolls under the $200 ceiling and handed down a 1½ percent allowance all down the line. However, the contractors argue that since the Board changed the ceiling they have exposed a much greater percentage of payroll to premium payments than most other industries. Hence, in effect, they are paying the 1½ percent allowance given those industries in the lower wage brackets.

Shelton offered a weekly payroll unit to illustrate:

	$100 Limitation	$200 Limitation
3 Derrickmen	$ 285.12	$ 285.12
3 Motormen	285.12	285.12
6 Helpers	537.84	537.84
3 Drillers	300.00	382.32
1 Drilling Sup't	100.00	175.00
	$1508.08	$1665.40

Additional payroll exposed to premiums in this instance is the difference between $1665.40 and $1508.08 or $157.32, which is a 10.432 increase.

"We wish particularly to emphasize," Shelton told the Board, "that this is a payroll adjustment which in no way involves an exposure of the carriers to any greater hazard of manhours worked . . ."

The carriers advanced other sobering arguments for a higher rate. The Texas Employers' Insurance Association of Dallas, which was created by the Texas Workmen's Compensation Act to insure employers at cost, and which is a heavy insurer of oil field activities, reported that:

- In the February, 1948, rates 55.8 percent of the claims reported to the association listed a maximum indemnity rate of $25 per week, and by the end of 1951, wages had risen to

Increases in Texas Compensation Insurance Rates

(Premiums computed on each $100 of payroll)

	From	To	Percent Increase
Oil or gas geologists or scouts	.35	.42	20.0
Oil or gas lease work	4.31	4.97	15.3
Oil gas wells—cementing	3.47	3.80	9.5
Oil or gas wells—development	7.80	10.05	28.8
Oil or gas wells—casing recovery	16.90	19.78	17.0
Oil or gas wells—logging	1.02	1.22	19.6
Oil or gas wells—perforating	2.60	3.46	33.1
Oil or gas wells—speciality tool	2.14	2.70	26.2
Oil rig or derrick erecting	9.70	11.46	18.1
Oil well equipment drillers—second hand	5.90	7.42	25.8
Oil or gas pipe line construction	7.26	9.61	32.4
Oil or gas pipe line operation	1.33	1.22	*8.3
Oil or gas producing	1.89	1.91	1.1
Oil or gas—still erection or repair	3.31	4.46	34.27
Oil or gas well service by contract	7.45	9.06	21.6
Oil refining—petroleum	.99	1.01	2.0

* Decrease.

Here's the new compensation bill . . .

LEGISLATION WHICH would completely overhaul the administration of workmen's compensation will be introduced at the current session of the Texas Legislature. One bill provides, in substance:

- A change in attorney's fees to a flat 15 percent of the award, with a maximum limitation of $1500. This would be a considerable reduction in fee levels, but would still allow the attorneys more than the average in other states.
- An increase in the maximum weekly benefit from $25 to $30 and an increase in the minimum from $9 to $12.
- Elimination of the method of compensation calculation as set up by the Holmes case.
- A simpler procedure for taking care of a minor or minor beneficiary to eliminate costly guardianship.
- A more realistic approach to situations involving pre-existing injuries. An effort would be made to determine how much responsibility the insurance carrier should have for aggravation of an old injury.
- A provision allowing for self-insurance with adequate safeguards. Self-insurance is now possible only through a separate company.
- A change in the entire mediation setup. The Industrial Accident Board would continue with three members, but would have final jurisdiction over fact. No appeal would be permitted except on points of law. Traveling commissioners would hear evidence and make determination of claims. Appeal from their decisions would be to the Industrial Accident Board.

Other legislation planned includes verification of the legality of the retrospective rating plan, which though widely used is now the target of at least one suit in Texas. Retrospective rating provides that between designated minimum and maximum limitations, the actual losses of the individual assured shall govern the premium for the risk. It is superimposed on the regular rating procedure and adjusts the standard premium to the actual risk conditions.

There will also be legislation to set up an Assigned Risk Pool or Plan under which risks otherwise unacceptable would be distributed among the various insurance carriers.

the point where 80.2 percent of the claimants were entitled to the maximum weekly benefits.

- From February, 1948, through February, 1952, average daily wages rose 34 percent. Normally, increasing wage scales have a tendency to reduce loss ratios, but procedures connected with settling indemnity claims in Texas have more than offset this.
- In the 1949 calendar year the loss ratio in Texas was 52.4 percent, or 90 percent of the allowable in the rate. In 1950 the loss ratio moved to 63 percent and continued to climb in the following year until it reached 69.6 percent by the end of 1951, which is 20 percent higher than the allowable in the rate.

Since premium volume influences compensation rates, and the number of insured firms in any industry dictates the volume, the American Association of Oilwell Drilling Contractors conducted a survey to investigate the claim attributed to some carriers "that it is almost impossible for a drilling contractor to obtain workmen's compensation insurance at the present rate."

The 279 Texas members of AAODC were asked whether they had experienced no difficulty, slight difficulty, some difficulty, considerable difficulty, or had found it almost impossible to obtain workmen's compensation insurance at the former premium rate of $7.80 per $100 of payroll.

Result of the poll as of November 19:

	Response	Percent	Rigs	Percent on Rig Basis
No difficulty	136	73.1	754	79.4
Slight difficulty	14	7.5	66	6.9
Some difficulty	22	11.8	87	9.2
Considerable difficulty	9	4.8	29	3.1
Almost impossible	5	2.7	14	1.5
Totals	186	99.9	950	100.1

The AAODC considers it particularly significant that there was no difficulty in insuring 79.4 percent of the rigs operated by 136 Texas members.

To the insurance companies, the necessity for the higher premiums is as unarguable as a mathematical formula. Because there is no existing method for recording the accident frequency of all companies in all industries, the payrolls of the insured firms are divided into their losses to arrive at a pure premium. This figure is multiplied by a factor to cover the carriers' operating expenses. The final sum is reconciled to current and expected conditions and then recommended to the Board of Insurance commissioners.

Rather than blame the insurance companies for higher rates, declared Ben H. Mitchell, executive vice president of Texas Employers' Insurance Association, the drilling contractors can point to certain of their employes, themselves, and the outlandish cost of settling claims.

Mitchell noted that all available figures indicate a nationwide increase in accident frequency since 1950. This, he said, coincides with an increasingly tight labor market which has pulled some of the better class of workers into stable industries and away from such comparatively nomadic work as drilling. The result has been an influx of inexperienced labor and a parallel rise in accident frequency.

Again, said Mitchell, the tight labor market with its guarantee of jobs for all has brought about a psychological change. There is unrest, which causes turnover, which forces employers to use inexperienced workers, and again the rise in accident frequency.

Employers can help lower their rates in two principal ways, said Mitchell. First, they can enforce the basic tenets of sound safety practices; and second, they can influence amendments to procedures under which compensation awards are granted.

To lower the accident frequency rate, which is the simplest and surest way to bring down insurance costs, the Texas Employers' Insurance Association has set up a basic safety program which has had spectacular success wherever applied. It is as follows:

1. Every supervisor should be put

Identification Questionnaire

FIGURE 1.

Foreman's Report of Injury

FIGURE 2.

on notice that unsafe practices will not be tolerated.

2. The Identification Questionnaire (Figure 1), which is furnished by the association, should be filled out for every new employe. Use of this form will help prevent accidents by keeping workers off jobs for which they are unfit; and it will also reduce compensationitis racketeering by giving the carriers a complete history of the employe's injuries and claims.

(Mitchell pointed out that no employer would hire a stranger and give him the combination to the safe, yet many employers habitually fill jobs without any investigation of the applicant, thereby exposing their carriers to $10,000 compensation awards which will be reflected in higher insurance rates.)

3. The Foreman's Report of Injury (Figure 2), a form also furnished by the association, should be used to report each accident promptly. This will promote speedy and fair claims settlements.

4. Each firm's accident experience should be studied every three months to determine whether the safety record is improving, and if not, why not.

5. Someone in top management should take a vigorous interest in the safety program.

6. Safety meetings should be held weekly.

The insurance association also advocates close attention to the human element involved in accidents. Under the Texas law an injured person receives no compensation during the first seven days (unless disabled for a period of four weeks, after which he receives payment for the entire period). Lack of money during these first seven days frequently causes great hardship, and unless the employer extends a helping hand, the worker will become bitter and may lend an eager ear to a compensation attorney's promises to win him a judgment ranging up to five figures.

This is particularly easy in Texas, where the intent of the compensation law is mocked by (1) the Holmes decision; and (2) the lack of authority vested in the Industrial Accident Board.

The Holmes decision, handed down in 1946 by the Texas Supreme Court, is generally held to be a bitter curse upon insurance carriers. It makes it possible, for example, for a highly paid worker to receive as much compensation for a 10 percent leg disability as for the loss of the entire leg.

The Texas Industrial Accident Board, consisting of a lawyer, an employer representative and an employe representative, was set up to administer the Texas Workmen's Compensation Act. But through misuse of the act, the Board has become little more than a stepping stone to the district courts.

The law makes the Accident Board the mediator in claims disputes but provides the right of appeal from its decisions. Moreover, appeals are encouraged by the law, which stipulates that where disputes are tried before the Accident Board, attorney's fees are to be 15 percent of the first $1000 and 10 percent of all in excess of that amount, but when disputes are appealed to the courts, the attorneys' fees jump to 33 1/3 percent of the award. Thus, if the Accident Board awarded a claimant $5000, the attorney would get 15 percent of the first $1000, or $150, plus 10 percent of the next $4000, or $400, for a total of $550. On appeal to the court, the attorney would receive 33 1/3 percent of the $5000, or $1666.66.

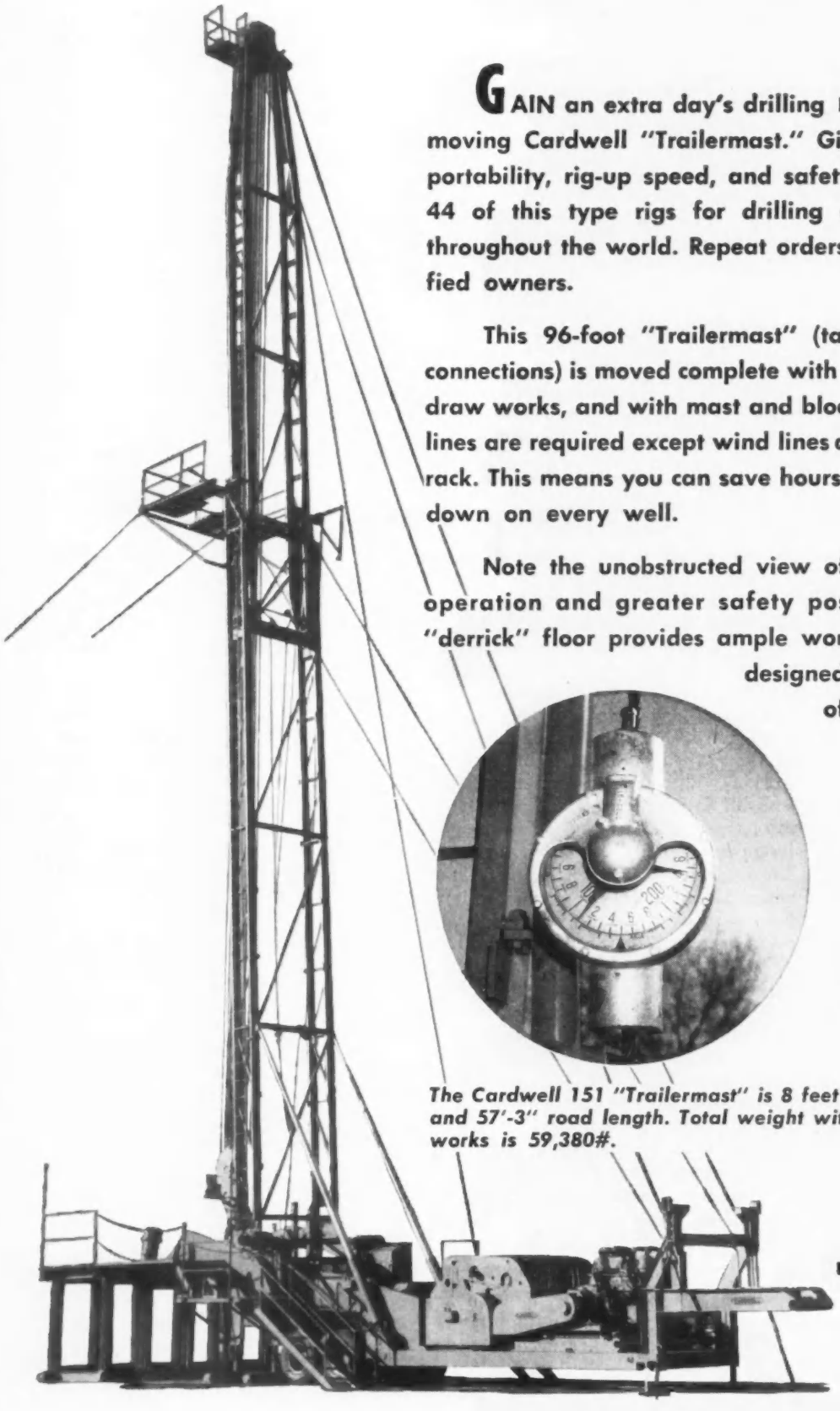
(Compensation procedures in some other oil states:

(Oklahoma — Industrial Commission is sole judge of the facts. Appeal can only be made to the State Supreme Court, and then only on points of law. However, attorneys' fees are fixed at 20 percent of the amount awarded, regardless of the amount of work performed by the attorney in the case. Hence, there is a mad scramble on the part of workmen's compensation attorneys to secure representation on these claims.

(New Mexico and Louisiana —

■ CONTINUED ON PAGE 64

The New CARDWELL 151



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This 96-foot "Trailermast" (tall enough for mousehole connections) is moved complete with a 5,000-foot single engine draw works, and with mast and block fully reeved up. No guy lines are required except wind lines and stabilizing lines to pipe rack. This means you can save hours of rigging up and tearing down on every well.

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150,000# with eight lines up.

The Cardwell 151 "Trailermast" is 8 feet wide, has 12'-6" road height, and 57'-3" road length. Total weight with double drum Model L draw works is 59,380#.

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TWENTY-FIVE YEARS CARDWELL SERVING THE OIL INDUSTRY

How to Reduce Lease Operating Expenses

Methods studies can improve coordination and working conditions.

By ROGER C. FILSON
Phillips Petroleum Company, Bartlesville, Okla.

IMPROVEMENT AND economy in oil producing operations can be achieved by a study of the methods employed in performance of work and by considering the time, effort and activities involved in each element of work.

Oil producing equipment is designed, constructed and selected for dependable trouble-free operations. Its performance is measured with precision instruments and subjected to rigid standards. Yet the ways of operating this equipment, which are equally important, are based on general notions, opinions and customs which are outmoded.

In fact, studies show that in many instances 70 percent of available work time is wasted in searching for tools, waiting on instructions, extra traveling between job and headquarters, or idleness due to limited work space or failure of equipment.

Methods studies are designed to reveal situations and conditions as they actually exist and reduce them to facts and figures so that they can be analyzed, discussed and corrected. In this manner, improved methods of operations can be developed and placed in use.

It generally is thought that methods studies are not adaptable to oil production jobs, due to the necessity of transporting men, tools, and supplies to the work site, while with other production jobs, the work is brought to the men. However, methods studies, if thoroughly understood and properly applied, can accomplish:

- More effective coordination of working groups.
- Reduction of time and physical effort requirements.
- Better working conditions.
- Efficient and economical utilization of tools, material and equipment.
- Improved design of tools and equipment.

The application of methods studies to any operation involves three major steps:

The first step is to determine exactly the objective, purposes and results to be accomplished in a job. This is done by observing the operation while it is in progress, breaking it down into measurable parts and recording accurately *why, how, where, when* it is being done, *who* does it and the average time required for each part.

The second step determines the essential work from the recorded data and develops the best methods and sequence of performing the essential work, using the least expenditure of effort and time. This is accomplished by subjecting each part of the factual data to the following questions:

- Can it be eliminated?
- How can the part be simplified?
- Can it be combined with some other part?
- Can it be performed at some other time?
- Could it be more efficiently performed by some other classification?

The best methods to perform each job will result from this analysis.

The third step is to design the jobs for maximum effectiveness and incorporate them into regular procedure.

The following exhibits taken from case studies of oil producing jobs show the increased job efficiency, by the savings in time, effort, and material, resulting from methods studies.

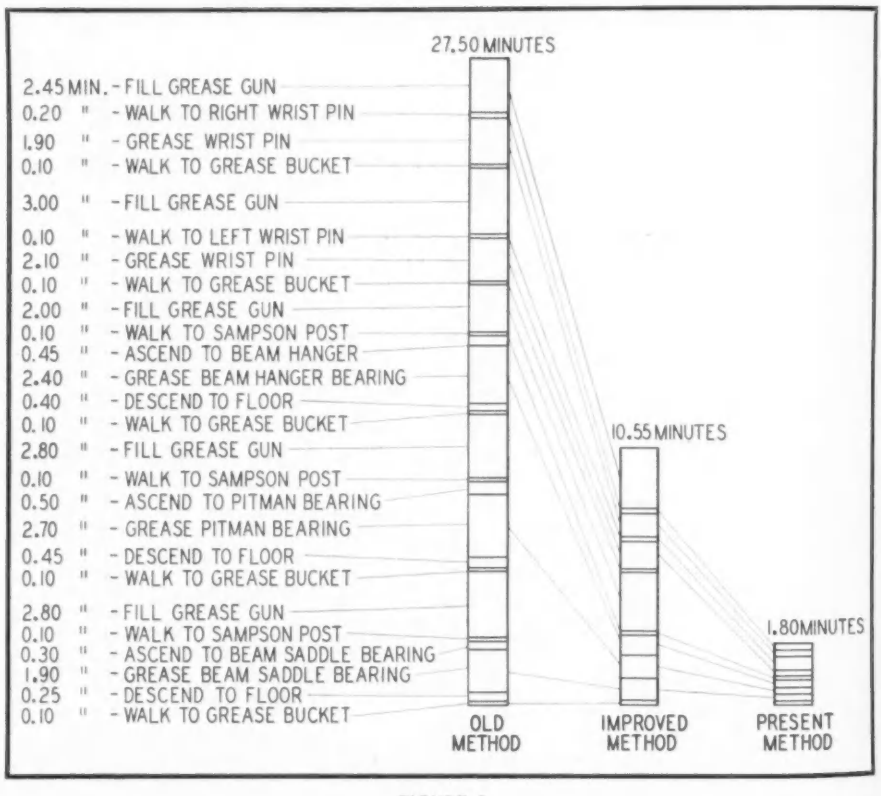

27.50 MINUTES
2.45 MIN. - FILL GREASE GUN
0.20 " - WALK TO RIGHT WRIST PIN
1.90 " - GREASE WRIST PIN
0.10 " - WALK TO GREASE BUCKET
3.00 " - FILL GREASE GUN
0.10 " - WALK TO LEFT WRIST PIN
2.10 " - GREASE WRIST PIN
0.10 " - WALK TO GREASE BUCKET
2.00 " - FILL GREASE GUN
0.10 " - WALK TO SAMPSON POST
0.45 " - ASCEND TO BEAM HANGER
2.40 " - GREASE BEAM HANGER BEARING
0.40 " - DESCEND TO FLOOR
0.10 " - WALK TO GREASE BUCKET
2.80 " - FILL GREASE GUN
0.10 " - WALK TO SAMPSON POST
0.50 " - ASCEND TO PITMAN BEARING
2.70 " - GREASE PITMAN BEARING
0.45 " - DESCEND TO FLOOR
0.10 " - WALK TO GREASE BUCKET
2.80 " - FILL GREASE GUN
0.10 " - WALK TO SAMPSON POST
0.30 " - ASCEND TO BEAM SADDLE BEARING
1.90 " - GREASE BEAM SADDLE BEARING
0.25 " - DESCEND TO FLOOR
0.10 " - WALK TO GREASE BUCKET
10.55 MINUTES
1.80 MINUTES
OLD METHOD
IMPROVED METHOD
PRESENT METHOD

FIGURE 1.
Activity chart covering the greasing of an oil well pumping unit.

Old method vs. the new . . .

The Old Method (see Figure 1) gives a static picture of the work performed to grease the pumping unit. This picture shows the sequence of the elements of work involved and the time required to perform each element.

The Old Method of greasing a pumping unit requires 27.50 minutes. By using the proper amount of grease

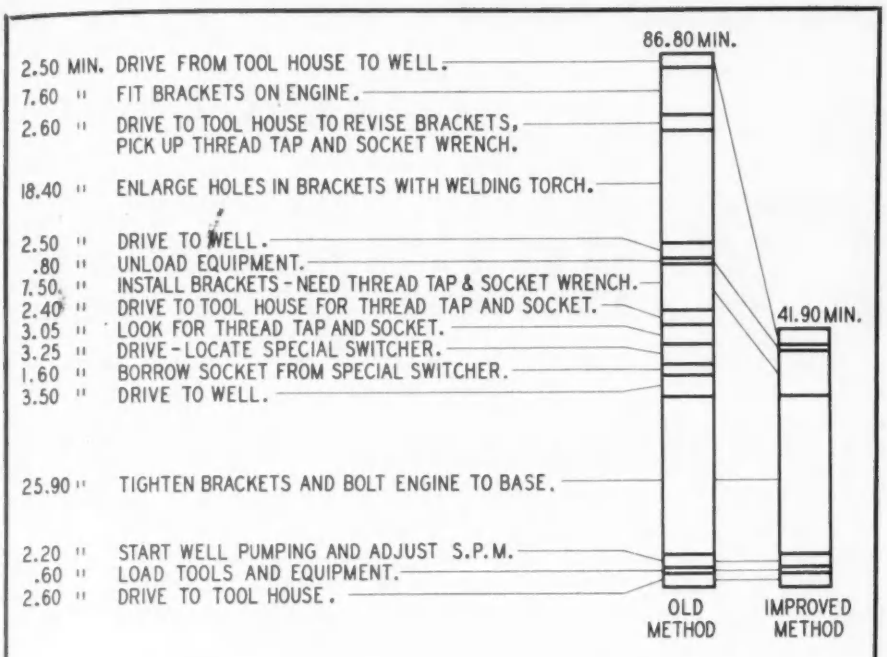
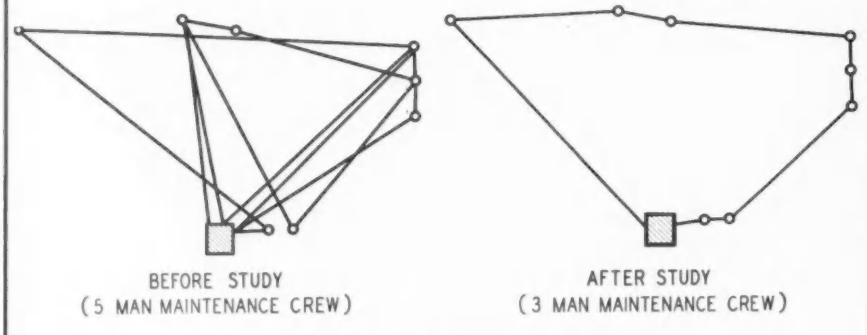

86.80 MIN.
41.90 MIN.
2.50 MIN. DRIVE FROM TOOL HOUSE TO WELL.
7.60 " FIT BRACKETS ON ENGINE.
2.60 " DRIVE TO TOOL HOUSE TO REVISE BRACKETS, PICK UP THREAD TAP AND SOCKET WRENCH.
18.40 " ENLARGE HOLES IN BRACKETS WITH WELDING TORCH.
2.50 " DRIVE TO WELL.
.80 " UNLOAD EQUIPMENT.
7.50 " INSTALL BRACKETS - NEED THREAD TAP & SOCKET WRENCH.
2.40 " DRIVE TO TOOL HOUSE FOR THREAD TAP AND SOCKET.
3.05 " LOOK FOR THREAD TAP AND SOCKET.
3.25 " DRIVE - LOCATE SPECIAL SWITCHER.
1.60 " BORROW SOCKET FROM SPECIAL SWITCHER.
3.50 " DRIVE TO WELL.
25.90 " TIGHTEN BRACKETS AND BOLT ENGINE TO BASE.
2.20 " START WELL PUMPING AND ADJUST S.P.M.
.60 " LOAD TOOLS AND EQUIPMENT.
2.60 " DRIVE TO TOOL HOUSE.
OLD METHOD
IMPROVED METHOD

FIGURE 2.
Activity chart illustrating a two-man maintenance crew installing a mounting bracket.

and elimination of travel time through the installation of ground greasing lines, the work of greasing a pumping unit can be performed in 10.55 minutes as shown in the static picture of the Improved Method. Reduction in the time required to grease a pumping unit is 63 per cent.

Filling the grease gun is the largest element of work. By analyzing each activity, it was determined that by using the proper amount of grease the work of filling the grease gun could be reduced from 13.05 minutes to only 4.45 minutes. The second most time-consuming element of work is travel. Careful analysis of this element reveals that by installing ground greasing lines from the pitman bearing, saddle bearing and beam bearing, running down to a working level height on the sampson post, the ascent and descent to and from the beam can be eliminated.

Analysis of the Improved Method shows that by using a power grease gun, the work of filling a hand grease



	BEFORE	AFTER	% REDUCTION
MILES	42.9	15.3	64
TIME (MINUTES)	130	45	65

FIGURE 3.
Activity chart illustrates how one day's travel of a five-man maintenance crew was reduced 64 percent.

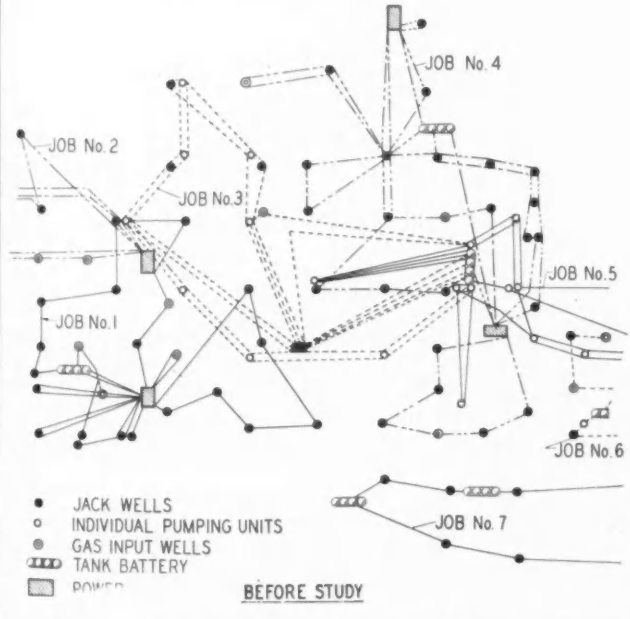


FIGURE 4.
Travel chart showing a portion of routes walked by various pumpers, before a study was made in an oil producing field involving 355 wells and 14 pumping jobs covering an area of approximately 3000 acres.

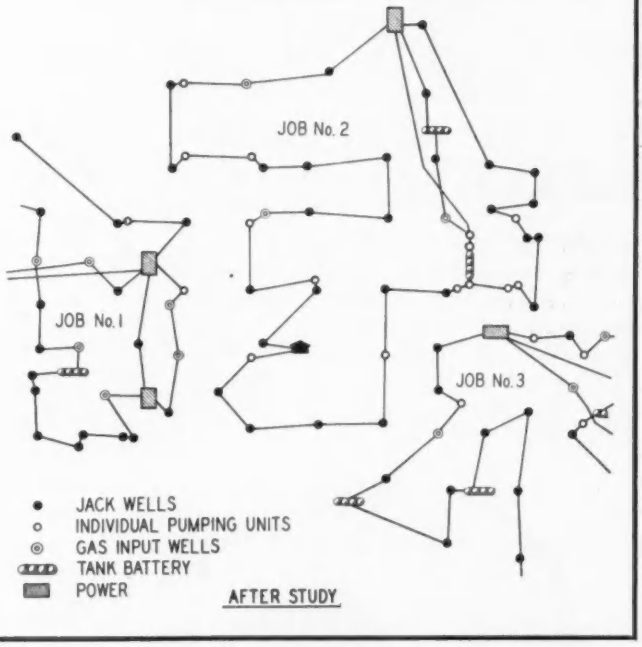


FIGURE 5.
Proportionate travel chart depicting a 67 percent reduction in travel routes used after completion of a Methods Study of field in Figure 4. Use of these routes cuts travel distance per day from 75 to 25 miles. Reduction made possible by determining frequency each principal field item should be visited by pumper.

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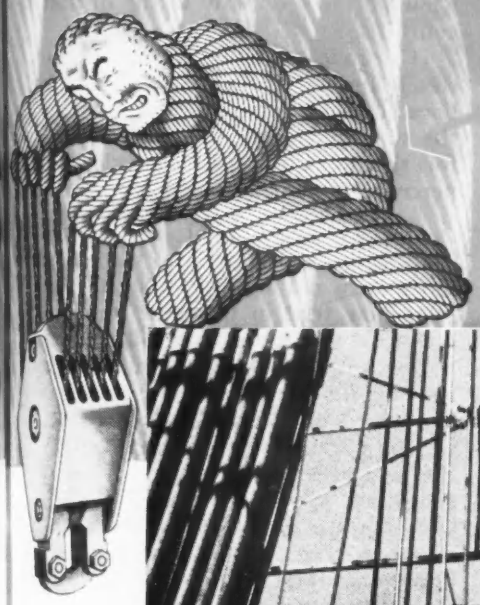
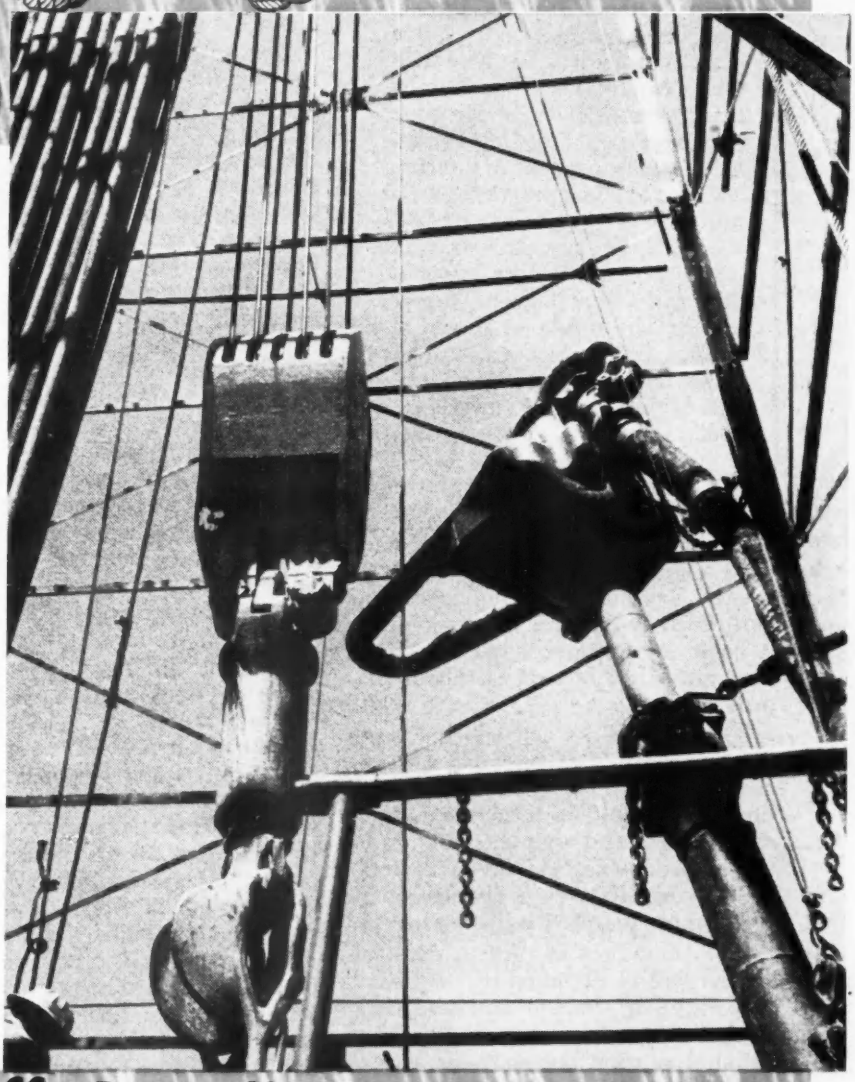
Signs of Wear"... with





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gun will be eliminated. Also, the physical effort of operating hand pumps will be eliminated and the bearings greased in a shorter time. With the use of a power grease gun, the work of greasing a pumping unit can be reduced to 1.80 minutes per job as shown in the static picture of the Present Method.

In addition to reducing the time required to grease a pumping unit, this analysis will determine the proper type and the correct amount of grease to use. Also, it will aid in setting up a procedure whereby the pumping unit will be properly lubricated at the correct intervals.

An analysis of this job shows that upon applying the bracket, certain holes had to be made larger (see Figure 2). A thread tap and socket wrench were needed to install the bracket.

The bracket was taken back to headquarters and the holes were made larger with an oxy-acetylene cutting torch. A search was made for the tap and socket wrench. When they were not found, the crew decided to return to the well and try to do the job with the tools they had.

Upon trying the bracket, it was found that the tap and wrench were necessary, so a return trip to the shop was made. A more thorough search was made to no avail. However, they were informed that a switcher had the tools, so the crew drove to the switcher's job, located him, and borrowed the tools. They returned to the well, completed the job, and drove to headquarters.

An analysis of the chart shows that 44.9 minutes, or 51.7 percent of the time could have been eliminated by proper planning and an adequate number of tools for each crew.

The left side of Figure 3 shows the travel routes of a crew visiting eight work sites in an average work day. The right-hand figure represents the travel routes after a study of methods was completed and analyzed. In order to increase the efficiency of the crew, the following procedures were established:

- Obtain sufficient information concerning each job, in order to predict the necessary crew size, tools, and repair parts required in a full day's work.
- A system of reporting and assigning priority to jobs, so that when a day's work was scheduled it would not be interrupted.

Figures 4 and 5 may seem farfetched and not representative of your operations, but you cannot be sure until a study is made. Very often the average person observes a job being performed and has the impression that it could be improved, but too often does not know how to go about improving it.

The possibilities of reducing costs through a study of methods was exemplified when the extensive application of these studies to each activity in the pumping and maintenance jobs in one oil producing field, involving 1600 wells, reduced the costs of these operations more than $\$1/4$ million per year.

The best results from methods studies will be obtained by the use of a competent trained analyst. This work is not only interesting and educational in itself but provides an excellent foundation for the future. It applies the fundamentals of sound industrial management and constantly seeks technological improvement, greater productivity and better performance with available manpower, machines and material.

A study of your operating methods will give a yardstick to accurately measure labor requirements and costs. It will show ways to offset higher costs. It will provide means to more effectively utilize all the skills present employes now have and to utilize present equipment more productively.

About the Author

ROGER C. FILSON, coordinator of methods analysis, Production Department, Phillips Petroleum Company, Bartlesville, Okla., has a background of more than 25 years of oil field production experience. Since 1945 he has been actively engaged in directing methods analysis programs in the principal oil producing areas of the U. S. For the past six years he has been conference leader of the yearly "Job Design" conference held by Oklahoma A. and M. College, Stillwater, Okla., and has served on various panels and seminars of other colleges and oil companies in the Mid-Continent area.

Compensation Laws

• CONTINUED FROM PAGE 57

Claimant goes directly to the district court.

(Colorado—Claims are settled by the Industrial Commission, which does not encourage attorneys to enter the suits and awards them fees only for the work they actually do. No percentage payment is allowed.)

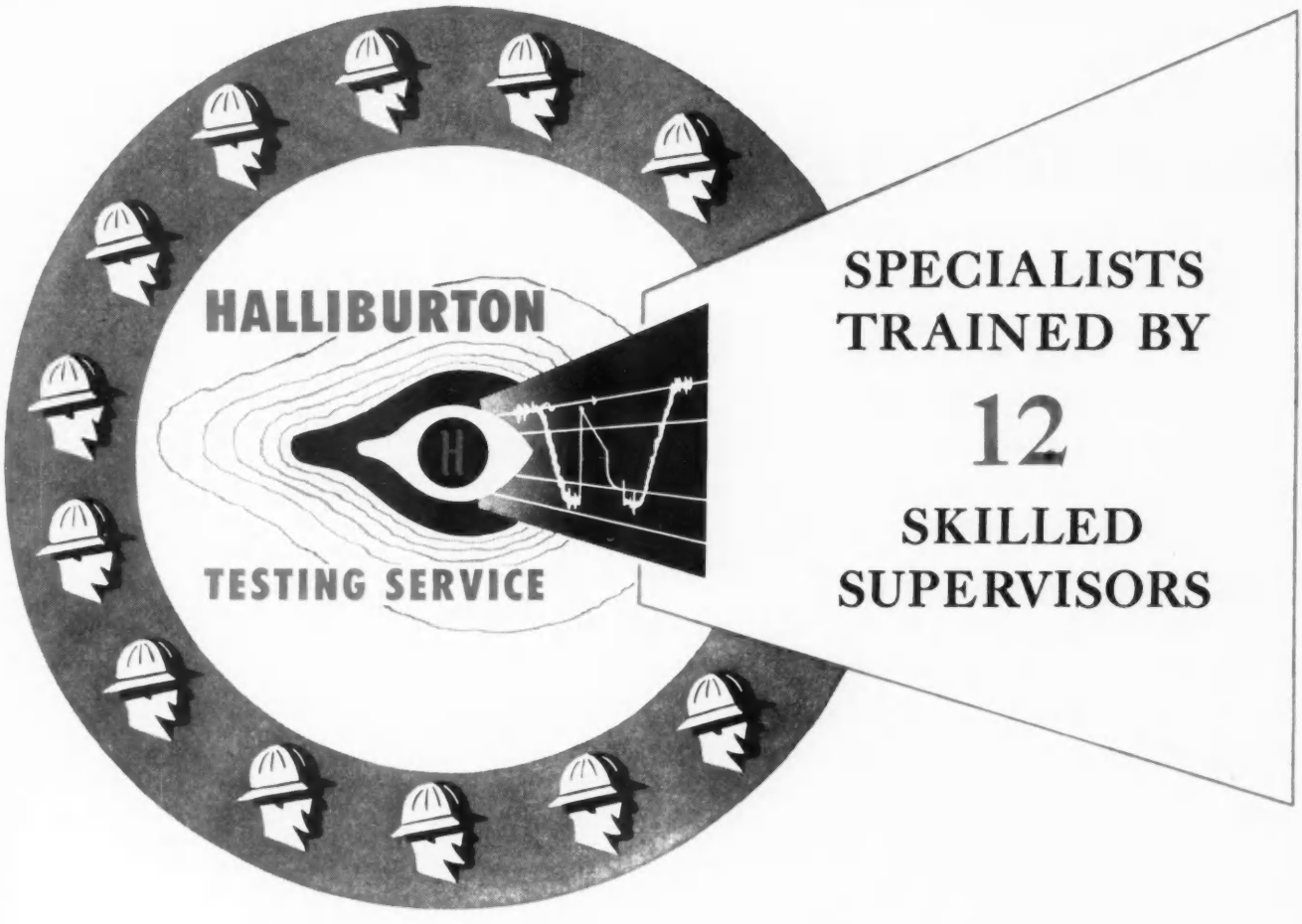
New Trial

Actually, a case going to the courts in Texas is not an appeal but a complete new trial in that any opinions expressed by the Accident Board cannot be presented to the jury, which is thereby deprived of the experience and knowledge of the Accident Board.

This situation is aggravated by (1) the average juror's sympathy—and sometimes, it would seem, the judge's also—for the plaintiff's claims as opposed to the rights of the big and impersonal insurance carrier; and (2) the inflationary gap between the $25 maximum weekly benefit allowed under the law and the amount needed nowadays for subsistence. For example, an employe with an average weekly wage of $100 and suffering an injury resulting in 25 percent permanent partial loss of use of a leg would be due 200 weeks' compensation at $15 per week (25 percent x $100 x 60 percent of the average weekly wage allowed under the law.) Since $15 is below subsistence level, jurors are prone to make lump sum settlements, frequently the maximum, thereby giving the compensation rates another upwards nudge.

Here is an ordinary case illustrating the Accident Board's impotence, the jurors' sympathy for the claimants in the face of strong evidence, and the tendency toward lump sum payments: A claimant alleged that while climbing a ladder he fell, straddling a rung, and sustained a double hernia. The Industrial Accident Board entered an award at the maximum of $25 weekly for an indefinite period not to exceed 26 weeks ($650). He appealed. In court, the defense produced records of the Industrial Accident Board on two previous claims by the plaintiff, one for a leg injury for which he collected $370, and the other for a back injury on which he collected $3312. Two physicians testified that the plaintiff did not have a hernia. An official of the firm employing the claimant at the time of the injury testified that the plaintiff had come to him saying he would drop the suit if the company would promise him employment.

The jury returned a verdict of total and permanent disability and awarded $10,025.



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Competition Is Becoming Stiffer

• For the first time in several years supply now substantially exceeds demand.

• Lubricants, heavy fuel oil and gasoline are selling below ceiling prices.

• Independent producers demand imports curb as domestic crude demand holds down allowables.

• Texas Railroad Commission hearing to bring out testimony on stocks and imports.

• Fears voiced that drilling may be hit and development of reserve producing ability stopped.

By L. J. LOGAN, WORLD OIL Staff

LIKE SOME OTHER lines, the petroleum industry apparently faces a situation of having potential supply well above prevailing demand. No serious surplus of oil is indicated. But supply is plentiful enough to threaten some glutting of markets and forcing of oils into storage in excessive volumes.

It has been stated by the president of a major company that the U. S. now has a productive capacity of 1 million barrels a day in excess of current demand. This was a goal set up by the government and the industry in connection with national defense, and during 1952 this goal was achieved, according to the executive.

Another oil company executive has pointed out that the federal government has urged further expansion and development of a cushion of reserve production capacity of 25 percent. He added that it remained to be seen whether the industry could afford so large a reserve. For the first time in several years, he stated, supply has caught up with demand, and some petroleum products, notably lubricating oils and heavy fuel oils, are selling generally below ceiling prices, while gasoline also is priced below ceiling in several areas.

That the supply of petroleum now is in danger of exceeding demand is evidenced in the friction that is developing within the industry between independent domestic producers and major companies that import petroleum. Reductions in allowable for domestic producers have caused them to blame imports and threaten a fight against imports unless they are voluntarily curbed by the importing companies.

Texas Independent Producers & Royalty Owners Association in late December sent a telegram to heads of six major importing companies demanding expression of company intentions on imports for the coming year. The telegram declared that imports had climbed above 1 million barrels a day and were 30 percent above a year ago.

It added that Texas output had been cut 157,640 barrels daily during the past two months, because of oversupply, while imports had continued their uninterrupted climb to an all-time peak of 1,239,000 barrels daily for the week ended December 13.

Imports already are supplanting domestic production to the point that exploration and drilling essential to national security are being retarded, TIPRO declared.

Importers Defend Action. Several of the importing companies replied that their imports were only slightly or no higher than in other recent years. One said imports in 1951 had been abnormally low because of abnormally high domestic production in supplying world shortages caused by stoppage of Iranian output. Several stated that one important reason for higher current imports was the acute West Coast crude shortage that necessitated imports from the Far East and elsewhere.

One importer said its receipts were asphalt and some residual fuel oil. One of the companies declared that it still supported what is supposed to be the general policy of the U. S. industry of using imports only to supplement and not to supplant domestic crude. It added that its information indicated that imports were not out of line with domestic production and such disparity did not appear imminent. Most of the importing companies stated that they had no intentions of making any substantial increases in the volumes of their imports, though several said that they might have to continue or increase imports to the West Coast if domestic supply remains inadequate.

One of the larger importing companies, Standard Oil Company (New Jersey) estimated that it would increase imports of crude by 9.1 percent to 108,000 barrels daily in 1953 from 99,000 a day in 1952 and boost imports of residual fuel oil by 14.7 percent to 172,000 daily in 1953 from 150,000 daily in 1952. That company insisted that it was in agreement with the policy adopted by the National Petroleum Council declaring imports should supplement but not replace domestic production.

One of the importing companies (Socony-Vacuum Oil Company) declined to offer information on its importing plans. It replied that it did not believe its plans would be discouraging to Texas producers but doubted

■ CONTINUED ON PAGE 69

Oil vs. Politics

• How long can the free world's growing appetite for petroleum be satisfied?

• The stumbling blocks are political and not geological.

• Can demands be met if the risks are not reduced, support of nationals abroad restored?

By MAX W. BALL

PER CAPITA USE of oil is growing rapidly throughout the free world. This represents a strengthening against Communism, from without and within. Oil consumption per person and the standard of living go hand in hand. Average use of oil and average income rise together. Rising national income increases a country's ability to resist Communist aggression from without. A rising standard of living lessens the danger of Communist diffusion within.

The world continues to be supplied with all the oil it needs. Nearly all of the huge job of supplying the ever-growing demand is done by competitive, private industry, which recently substantiated its vigor and resourcefulness by promptly supplying markets left without oil when Iran nationalized its oil industry and ceased production.

But how long can the free world's great and growing appetite for oil be fully satisfied? The answer must be given in two parts, one geological and one political, one clear and the other cloudy.

The geological part is easy and positive. There is plenty of oil in the ground, enough for the world's growing needs for many years to come. Given a fair chance, oil men will find and produce it as fast as it is needed.

It is a long road, however, from oil in the ground to oil found, produced, transported, refined into needed products and distributed for world-wide use. The stumbling blocks along that road are not geological. They are political. Some of them are more than stumbling blocks. They come nearer to being roadblocks. Among the blocks are excessive taxation at home, excessive exactions by countries where oil is produced, doors closed to exploration and insecurity of investment.

The chief risks to an adequate future supply of oil for the free world's needs are political. Unless those risks are minimized by a firm foreign policy, the world's oil needs may not be met.

Excessive Taxes at Home. Expected to grow between 20 and 35 percent in five years, the petroleum industry, though employing already a huge capital investment, must invest further huge sums to expand its capacity. Historically, a substantial part of the funds for expansion has come out of earnings. Taxation at present levels threatens the continuation of this policy of plowing earnings back into the business.

It also threatens to dry up the sources of venture capital from which new funds might be obtained. The new high rates have been in effect for a comparatively short time. If long maintained, they will impair the industry's ability to plow back earnings, raise new funds and meet needs for more oil.

Excessive Exactions Abroad. Excessive taxation at home furnishes an obvious excuse for excessive exactions by countries where the oil is produced. It's easy to understand King Ibn Saud's recent complaint. He complained that the government of the U. S., through its taxation of the American companies producing in Arabia, was getting more revenue from Arabian oil than the government of Arabia. Arabia furnished the oil; the government of the U. S. didn't furnish a penny toward finding, producing or marketing it. Yet the government of the U. S. got

. . . about the author

MAX WAITE BALL has been since 1948 an oil and gas consultant, specializing in geology, engineering and economics, with offices in Washington, D. C. He was director of the Oil and Gas Division of the Department of the Interior immediately after World War II, in 1946-1948. During the war (1944-1946) he had been special assistant to the Deputy Petroleum Administrator for War. Born in Munson township, Henry County, Ill., Ball received degrees in engineering at the Colorado School of Mines and in law at the National University, Washington, D. C. He was with the U. S. Geological Survey from 1906 until 1916 and then spent a year with the U. S. Bureau of Mines. In the years from 1917 to 1928 he served in executive capacities for the Royal Dutch Shell oil interests in the Rocky Mountain region, Western Pipe Line Company, Marine Oil Company, and Argo Oil Company. From 1928 to 1944 he maintained a consulting practice, and during most of that period he also served as president of Abasand Oils Limited and of Royal Royalties Limited, Denver. Ball was author of *This Fascinating Oil Business,* and has written numerous bulletins and articles on geology, economics and international relationships. He is affiliated with a long list of geological, engineering and other scientific societies and is a past president of the American Association of Petroleum Geologists.

more money out of it than the government of Arabia.

It's easy to understand, too, why the companies that have risked millions in finding and developing oil in foreign countries do something about such complaints; why they "voluntarily" make new and less advantageous agreements.

A company producing oil in a foreign country is at the mercy of the government thereof; it can't pick up its oil fields and move them to somewhere else; it renegotiates on demand, or else. It gets as much quid pro quo as it can, and tries to be thankful it doesn't fare worse. For the past 20 years, it could expect little support from its home government.

Thus the history of oil operations abroad is spotted with so-called voluntary new agreements, each more exacting than the one it replaced, each lessening the economic incentive to find and produce more oil.

Some countries have killed the goose that laid the golden egg. Some have chased it out of the country. Some have starved and harassed it till its egg-laying days are over. Other countries have merely reduced its diet, and thereby reduced the number of eggs it will lay hereafter.

Even Venezuela, often pointed to as a shining example, is underfeeding her golden goose. Thanks to liberal treatment when her oil industry was young, Venezuela is now the world's second largest oil producing country. The passing years have seen the exactions grow, partly by new agreements, partly by new legislation and regulation. Increased royalties, artificial pricing of royalty oil, underallowance for transportation, compulsory refining of oil in the country, adverse currency restrictions, special and general taxation have all added to the industry's costs.

Venezuela's government has been one of the fairest with which oil men have dealt, but wells are not being drilled that should be drilled. In some fields, wells are being abandoned because they can not pay their way. If and when world productive capacity exceeds world demand, Venezuelan oil will lose markets because of its artificially high costs.

The 50-50 Formula. Venezuela is the originator of the famous 50-50 formula. The formula has caught the fancy of politicians wherever oil is produced, including the U. S. State Department. It postulates that the government of the country in which the oil is produced should get half the profits from its production. It's a catchy sounding formula—and it has no economic justification, as only a little thinking will show.

Where a profitable industry is well established, with the hazards behind it of exploring a new country for oil and finding markets for its output, 50 percent of the profits may be fair enough. The U. S. government takes more than 50 percent of the profits of many oil companies, and except on public lands, it lacks the excuse of owning the oil in the ground, as most foreign governments do.

But where oil must be sought in remote areas, where producing, transportation, refining and distribution facilities must be provided for the oil that is found, and where a place for the oil must be found in competitive markets, then 50 percent of the profits may be prohibitive. This applies to unexplored areas in countries like Venezuela, as well as to countries not yet explored.

The 50-50 formula contains no magic. The sooner politicians forget it, and consider each case on its economic merits, the better the prospects will be for an adequate supply of oil for the free world.

Closed Doors. Too many oil exploration doors are closed to the people who know how to find oil and have the resources to do it. Whether the doors are closed by nationalization or by prohibitive requirements is immaterial; too many for the world's good are closed or virtually closed.

In some countries the door is open a crack; in some the back door is slightly ajar; but the kind of exploration the world needs isn't likely to creep in through a crack or slip in through the servants' entrance. So long as things remain as they are, adequate exploration is unlikely in such countries as Brazil, Argentina, Chile, Bolivia, Colombia, Mexico, Austria, Italy, Turkey or Egypt, all of which have geologic promise.

Nothing can be done about this, except to pray that time and increased wisdom will open these doors before the world's needs become acute—and perhaps to further our prayers with the example of success and fair dealing elsewhere. The U. S. has no right to try to tell any sovereign state how it should go about finding and producing its oil. The best that we can do is to continue to demonstrate facts already amply demonstrated: that countries that permit exploration by American companies lose none of their sovereignty and that their treasuries and their people benefit greatly thereby.

Insecurity of Investment. Last and greatest of all deterrents to foreign exploration is insecurity of investment. Developing oil in new territory requires great risk of great capital investment. When oil is found, neither the risk nor the need for funds is over. In most new countries, many years go by, and many millions are invested, before the enterprise begins to pay. Many more years go by before it achieves economic security.

The inherent risks of finding oil and finding a market for it are great enough. No one is likely to incur them except in the hope of great reward. No one takes such risks if he thinks that somewhere down the road lurk other risks: risks that his enterprise or part of his reward will be taken from him. If undue political risks are added to geological and competitive risks, the sum of the risks becomes too great. Oil exploration becomes unattractive.

Iran's Blow to Confidence. Iran dealt foreign exploration a hard blow in 1951, as Mexico did a quarter of a century ago. The confidence of the oil world and the investing world has been badly shaken.

A company had incurred the risk of exploring for oil in an unknown part of the world, had succeeded in finding it, had developed markets for it, and by investing new capital and plowing back earnings had built one of the world's great enterprises. It was paying the Iranian treasury about $40 million a year and had offered to pay nearly 70 percent more. It was operating under a contract negotiated under the auspices of the League of Nations, approved by the Shah and ratified by the Majlis without dissent.

Then the government declared the contract cancelled and took over the property in June, 1951. The only compensation offered the company was payment for its property from the proceeds of a fraction of its production.

The company says that its contract was cancelled and its properties confiscated without legal process. The government says that nationalization is always legal; that a government has a basic right to condemn any property for public use, a right that it cannot contract away. The significant fact is disputed by neither party: a year and a half ago the company had a contract

and a going enterprise; today it has neither an enterprise nor a contract.

Where Is Investment Safe? That happened in Iran in 1951. Where may it happen next? It can happen in any country that has not grown up enough to recognize the sanctity of its contracts, a recognition basic to honesty and fair dealing among men.

What countries have reached such political maturity? By their fruits ye shall know them. What oil producing countries with major oil possibilities, otherwise open to oil exploration, have never broken a contract with an oil company, or forced a revision of such a contract to the company's detriment?

The list is short. Possibly only a few countries, without stretching charity too far, belong on it. Begin with the U. S. and Canada. Add India, Pakistan and perhaps Afghanistan, though their virtue has not been tested. They are too new as states, or their oil is still undeveloped, or both. Add Israel. It has geologic promise. Its government is elected by universal suffrage and appears stable and trustworthy. It has a petroleum law that opens the country to competitive exploration by all qualified comers. The U. S., Canada, Israel, India, Pakistan and Afghanistan.

The criterion used to arrive at that list is admittedly severe. Some of the contracts that have been revised may have needed revision. They may have been unfair to the host countries. Little coercion may have been needed to bring about their revision. Those are easy conclusions to reach after the risks have been taken and the result has been success instead of failure.

Severe or not, by what other criterion can a country's honor be judged? What other test will show whether it holds its pledges sacred? If the list is dismally short, it only shows that keeping faith is not a universal habit among nations.

Should We Attempt Enforcement? Is there no means of enforcing a contract between a government and an oil company? The Court of International Justice may some day be an effective tribunal, if its jurisdiction extends to disputes between governments and those with whom they contract, and if all concerned come to accept its decisions. At present it meets neither of those tests.

There was a recognized rule of international law and practice for such cases. It held that a country protected the persons and property of its citizens wherever they went, and property included contract rights. The rule remains. The practice has grown more and more feeble. It has yielded bit by bit to a new theory: that we should not tell another country what it may or may not do to our citizens; that to do so would be interference in its internal affairs. It says to our nationals, in effect, "You venture abroad at your own risk."

The fashion of today is to sneer at the former practice, to call it "gunboat diplomacy." The term sounds damnable, but is a gunboat, used to enforce honesty and fair dealing, more damnable than a court order or a policeman?

The question of using or showing force is always a ticklish one. Even in the days when right outranked appeasement, enforcement of rights was subject to considerations of broader national interest. Such considerations would of necessity effect enforcement today. If the U. S. had backed British gunboats in the Persian Gulf, Russia might have moved into Iran. American rights in Guatemala are threatened with violation under what appears to be the direction of Moscow. If the U. S. should enforce them, she might lose such good will as exists in Latin America, but, on the other hand, gain new respect as a nation that protects its citizens. Firmness might make more friends than appeasement.

The State Department's job of deciding whether and when to be firm and when to appease is not an enviable one; whether and when to protect the rights of American citizens abroad; whether and when to insist that contracts made in good faith be kept; whether and when to permit other countries whose citizens are wronged to do the same.

It is suggested, however, that the free world's oil needs may not be fully met unless the political risks in some parts of the world are reduced, governments once more support the rights of their nationals abroad, and oil men can again have confidence in such support.

ACKNOWLEDGMENT

From an address before the Washington, D. C., chapter of American Institute of Mining and Metallurgical Engineers, Dec. 9, 1952.

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Competition Stiffer

■ CONTINUED FROM PAGE 66

the "propriety of advising your or any other trade association concerning our company's operating program."

Hearing to Consider Imports and Stocks. Directly affected by imports are crude production allowables in Texas and other states; and closely related to both imports and domestic crude production are the stocks of crude oil and refined products held in the U. S. The Texas Railroad Commission therefore proposes to take cognizance of the interrelationship of production, imports, and stocks to each other and the relation between all these sources of supply and the demand for petroleum. This it will do by drawing out special information at its February 18 statewide proration hearing. The commission is asking oil purchasing and importing companies to attend the hearing, prepared to offer estimates of the amounts of stocks of crude and products likely to be required in 1953.

Ernest O. Thompson, chairman-elect of the Texas Railroad Commission for 1953-1954, who announced the forthcoming hearing, said that a similar hearing was held two years ago and brought out testimony that was very helpful to the commission. It needs to review the situation at this time, he stated, because the commission is bound by the Texas market demand statute to do all that is necessary to "ascertain the market demand for Texas crude oil." He stated that the present situation, with imports high and Texas allowables being cut, could adversely affect producing ability and the national defense, because any reduction in allowables discourages drilling. Insufficient drilling and inadequate producing ability could have a bad effect on conservation in the future by ultimately forcing production in excess of maximum efficient rates in meeting demand for crude.

Thompson expressed concern over a decrease in Texas drilling permits to 18,055 in 1952 from 19,989 in the like period a year previously, a decrease of 1934 permits. He said this meant that oil operators were finding it increasingly difficult to drill wells. He added that increased imports apparently were having an adverse effect on domestic drilling.

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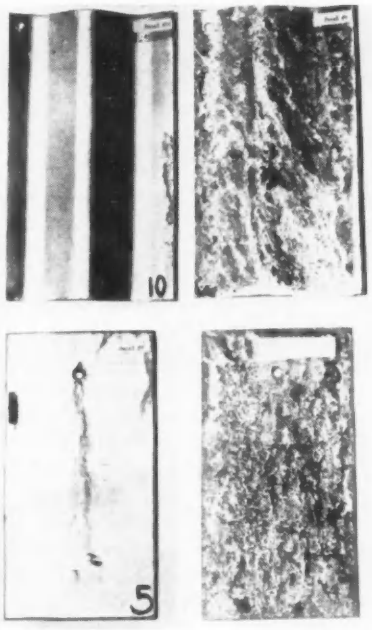
New Equipment

Supplementing Composite Catalog



Vinylite Resin Coating

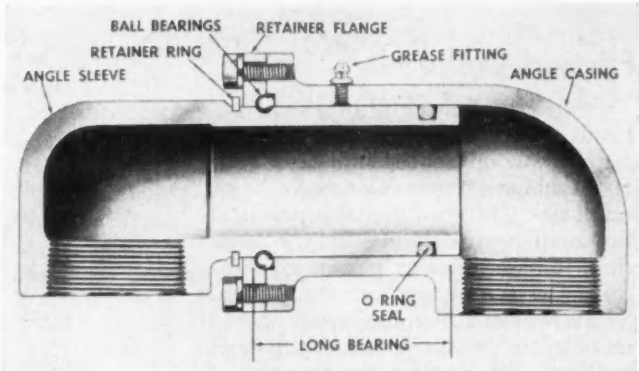
Galvanized iron treated with a Vinylite resin-based coating resists corrosion twice as long as ordinary galvanized iron under severe conditions of salt spray fog cabinet tests according to Plastic Coating Corporation, manufacturer of Vinylite resin-based coating. The coating, as shown in the photos, compared in durability with iron oxide primer and galvanizing. The top left photo shows a corrugated, galvanized iron panel exposed to salt spray fog cabinet conditions for 1204 continuous hours. It was treated with a wash primer and top coat based on Vinylite resins and shows no corrosive breakdown. The uncoated panel (top right) lasted only 672 hours under the same conditions. Two black iron test panels, bottom, both degreased and wire-brushed, were exposed 1204 hours. A Vinylite resin coating protected the bottom left panel, while the panel with a conventional coating of iron oxide primer broke down completely (bottom right).

This item supplements Union Carbide and Carbon Corporation data on page 4221 of Composite Catalog, 18th Edition.

Circle No. 12 on Postcard

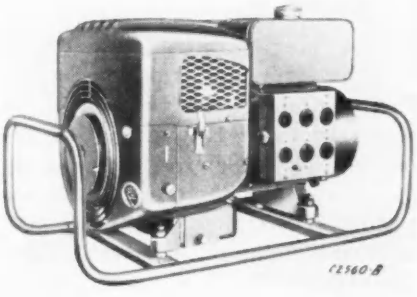
Ball Bearing Swing Joints

A new line of ball bearing equipped swing joints for use on loading and unloading lines handling liquids is announced by Barco Manufacturing Company. The design is distinguished by a long lubricated bearing which provides adequate support for piping, and an exclusive method of positioning the ball bearings—preventing them from falling out when the joint is taken apart. An O-ring confined in a recess in the sleeve of the joint seals the ball bearings in. The O-rings are specially made not to soften, swell, or deteriorate at any temperature from minus 30° F. to plus 250° F. These joints are also suitable for pressures as high as 1500 psi. hydraulic, depending on size and service. All parts are accessible for inspection.



This item supplements Barco Manufacturing Company data on page 463 of Composite Catalog, 18th Edition.

Circle No. 13 on Postcard



Electric Plant

A new 180-cycle, gasoline engine-driven electric plant designed to operate high frequency electrical work tools has been announced by D. W. Onan & Sons, Inc. At unity power factor it provides 5000 watts of A.C., 230-volt, 180-cycle, 3-phase power, or, 3000 watts, 230-volt, 180-cycle A.C. plus 2000 watts, 115-volt D.C. One model provides independent power for 180-cycle electric tools where no standard power is available for conversion. The unit is portable and powered by the lightweight Onan "CK" 2-cylinder, 4-cycle, air-cooled gasoline engine.

This item supplements D. W. Onan & Sons Inc. data on pages 3966-3967 of Composite Catalog, 18th Edition.

Circle No. 14 on Postcard

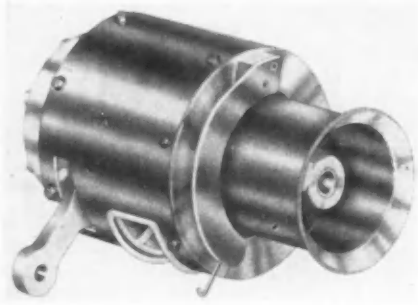
Stainless Steel Meter

Rockwell Manufacturing Company has developed a new 2 BC Rotocycle Stainless Steel industrial meter to handle corrosive liquids common to industrial processing. Based on the Rotocycle principle this new rotary displacement meter features a maximum capacity of 100 gallons per minute at a working pressure of 125 psi. All parts of the equipment coming in contact with corrosive liquids are made of stainless steel.

This item supplements Rockwell Manufacturing Company data on pages 4196-4199 of Composite Catalog, 18th Edition.

Circle No. 15 on Postcard

Save time! Keep informed! Circle numbers on postcard, page 71

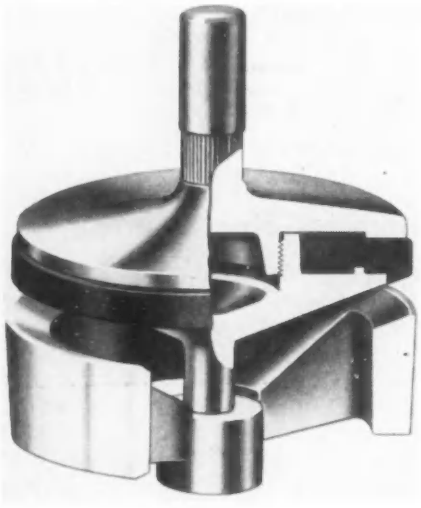


Friction Catheads

Friction makeup and breakout catheads designed for use on any size rig are now offered by American Iron & Machine Works Company. The small-size Universal model is practical for small rig installation, at the same time it has sufficient power to make up or break out any size connection. Small overall dimensions allow movement of the jerkline closer to the shaft bearings, eliminating the danger of kinking the shaft. Simple in design, the screw type engaging mechanism is factory adjusted and ready to mount to the shaft. The cathead is equipped with a safety rope divider designed to eliminate fouling of the catline. Both manual and air controls are available for both model types. Breakout model pictured.

This item supplements American Iron & Machine Works Company data on pages 217-268 of Composite Catalog, 18th Edition.

Circle No. 16 on Postcard

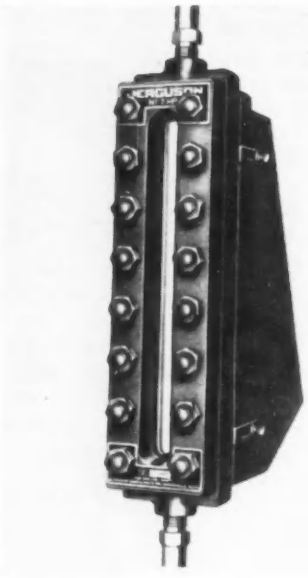


Slush Pump Valve

MacClatchie Manufacturing Company now offers a slush pump valve of the new type HP unit. Each of the three simple valve parts is designed for its particular purpose and all combined in a functional assembly. The parts are composed of rugged, all purpose rubber insert, a hardened steel (replaceable) body, and a hardened steel cap that can be used over and over again.

This item supplements MacClatchie Manufacturing Company data on pages 3097-3116 of Composite Catalog, 18th Edition.

Circle No. 17 on Postcard

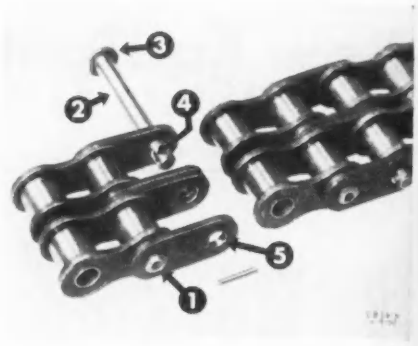


Steam Gauge Illuminator

A new illuminator for steam gauges has been announced by Jerguson Gage & Valve Company. It permits instant and accurate gauge readings of the boiler water level over longer distances, through dust particles in the air or deposits on the gauge glass, or in poorly lighted areas. Equipped with the Jerguson Mercury Vapor Illuminator, the gauge water column shows blue-green, topped with an intensely brilliant emerald green spot at the water level, to give an unmistakable water level indication. The illuminator consists of a mercury vapor bulb enclosed in steel housing, and a ballast box equipped for easy mounting at a convenient spot. The illuminator clips to the gauge cover with two sets of brackets, making installation easy.

This item supplements Jerguson Gage & Valve Company data on page 2589 of Composite Catalog, 18th Edition.

Circle No. 18 on Postcard



Riveted Roller Chain

Rig down-time due to premature chain failure and replacement has been claimed solved by Chain Belt Company who announce an improved, easy-to-assemble riveted roller chain. The improved Baldwin assembly riveted oil field roller chain is supplied in ASA standard and heavy series in 1- through 2½-inch pitch sizes in single and multiple widths. It is made up in ten-foot lengths of riveted chain having an exclusive Baldwin-Rex single pin coupler installed at convenient intervals. Spacing of the couplers vary depending on the chain size.

This item supplements Chain Belt Company data on pages 1215-1216 of Composite Catalog, 18th Edition.

Circle No. 19 on Postcard

Gas Engines

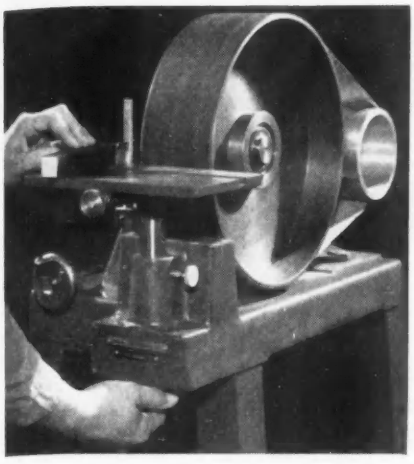
A four-cycle spark-fired gas engine series is announced by Nordberg Manufacturing Company. Types FSE-9 and FSE-13 engines are built with nine-inch and 13-inch bore sizes respectively in non-supercharged, supercharged, intercooled-supercharged and supairthermal types covering a range of 265 to 4260 horsepower. Both engines burn natural gas, butane, propane, manufactured gas and sewage gas. These engines have the same basic heavy-duty construction features of Nordberg four-cycle Diesel engines, and can be converted to 100 percent fuel oil or Duafuel operation. Thermal efficiency ranges in excess of 41 percent with Supairthermal type to 38 percent with non-supercharged engines.

This item supplements Nordberg Manufacturing Company data on pages 3676-3677 of Composite Catalog, 18th Edition.

Circle No. 20 on Postcard

Save time! Keep informed! Circle numbers on postcard, page 71

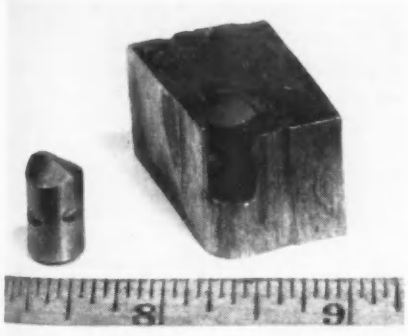
Other New Equipment



Abrasive-Belt Grinding

A method of abrasive-belt grinding has been developed through cooperative engineering of Behr-Manning Corporation and Fenlind Engineering Company. The machine for the new method uses a coated abrasive belt that travels over a cast iron contact wheel specially formulated for extreme hardness. Diamond grinding wheels are not used. This new method costs from 1 to 3 cents per tool ground to compare with 6 to 17 cents cost per tool sharpened by the conventional method.

Circle No. 21 on Postcard



Cone Bit Teeth

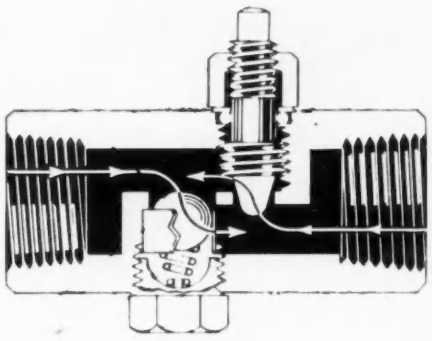
Use of carbide plugs made by Kennametal, Inc., as cutter teeth in cone bits has proved successful in drilling cherts, dolomitic sands, bromides and some igneous rock. It is most successful for drilling hard materials and formations below 10,000 feet. Performance reported includes penetration rates of 3 or 4 to 1 over steel cone bits, with increased rates of penetration in the harder formations. The cut-away section shows the critical thicknesses being dealt with in inserting tungsten-carbide plugs, together with plugs for reaming and digging. The cut-away also illustrates the plug mechanically secured by the extend steel "rib" acting on the notch in the plug.

Circle No. 22 on Postcard

Grease Applicator

A new method of applying lubricant to tool joints, drill collars, and other equipment, has been developed by Jet-Lube, Inc. The applicator avoids contamination and eliminates waste while providing complete coverage of the threads with maximum speed and ease of application. A trigger-operated control valve connected to a high-pressure hose carries lubricant under pressure from an enclosed container and pump. The flexible head is inserted into the box of the joint and the grease, in an enclosed system, is forced into the threads from the bottom to the top. Drilling fluids and contaminants are forced out.

Circle No. 23 on Postcard



Flow Control Valve

An improved flow control valve is being offered by Pneu-Trol Devices, Inc. The improved valve is efficient for air or hydraulic use. It provides full flow in one direction and a wide range of adjustments in the controlled direction. The valve now incorporates a floating retro-ball check and a new improved type gland structure needle. This gland structure combines the O-Ring sealing principle with an adjustment locking feature in a compact design. A light helical spring locates the ball in the most sensitive floating position to the seat.

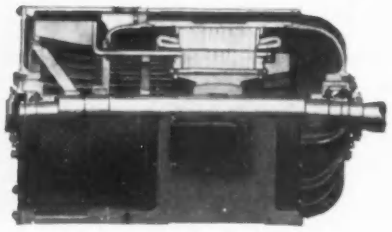
Circle No. 24 on Postcard

Pilot Valve

A new three-way solenoid controlled and pilot operated valve is made by Crescent Valve Company augmenting their line of four-way valves. Model 1034 is designed to control any light fluid medium such as air, water, and light oils. It provides a pressure range of from 20 to 500 psi. for normally open or normally closed service. With the three-way pilot valve partially housed in the main valve piston, the unit becomes very compact. All valves may be cycled continuously up to 600 cycles per minute for the smaller sizes.

Circle No. 25 on Postcard

Save time! Keep informed! Circle numbers on postcard, page 71

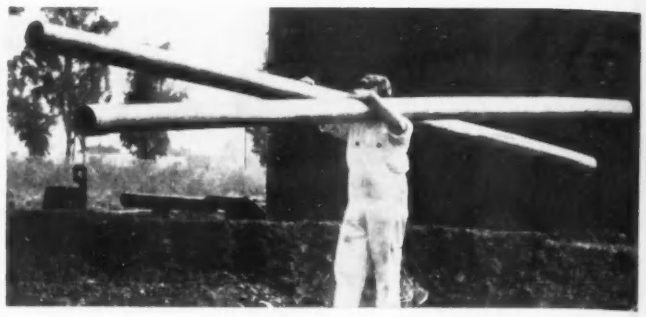


High-Slip Motor

A new enclosed, fan-cooled, high-slip induction motor designed for use in acceleration of high-inertia loads is made now by General Electric Company. Designated type KRX, the new motor is claimed to be as much as 30 percent smaller and 40 percent lighter than conventional motors of the type. Space and weight reduction is attributed to the new extended-bar design which provides efficient dissipation of the increased heat normally generated by high-slip motors.

Circle No. 26 on Postcard

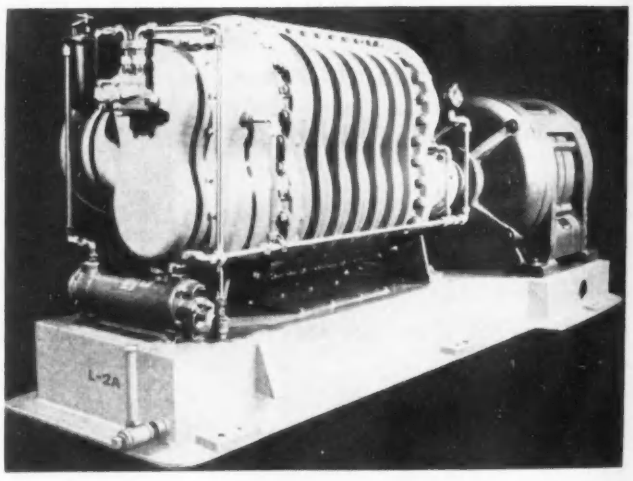
Glass-Fiber Pipe



A new glass-fiber reinforced-thermosetting plastic pipe for pressure transmission uses is now offered by Reflin Company. Allowable pressures of this pipe are higher than previously allowed, resistance to heat and impact loads are greater, and physical properties at extreme temperatures are improved. The new pipe comes in sizes larger than any other plastic pipe now on the market. It is resistant to most salts, acids, hydrocarbons and natural corrosive elements commonly found in pipe line applications, and is unaffected by electrolytic corrosion. Operating temperatures range from minus 90° F. to 230° F. Lightweight and rigid, installation can be made by two men under average terrain conditions.

Circle No. 28 on Postcard

Spiral Axis Compressor



The Spiraxial Compressor made by Roots-Connersville Blower is a gas or air compressor utilizing screw-rotors which rotate in opposite directions. These screws are operated by gears synchronized to prevent contact, allowing close but definite clearances between them. The "Spirotors" are formed along a spiral surface accurately generated to maintain correct clearances. Air or gas flow is axial with most of the compression taking place at the back of the casing, a situation which permits a very large inlet opening.

Circle No. 29 on Postcard

Pressure Blower

A high-pressure blower that quickly removes fumes, smoke, dust and odors is being offered by Standard Electric Manufacturing Company, Inc. The precision made, all-aluminum, blower moves up to 450 cubic feet of air per minute. On the standard unit, made with a 5½-inch inlet and 3½-inch outlet power is supplied by an enclosed one-sixth horsepower Westinghouse motor of a 115 volts, single phase alternating current, 3450 rpm type. Larger sizes and greater speeds are available.

Circle No. 27 on Postcard

Packaged Extinguisher

Standard Pak carbon dioxide fire extinguishing systems manufactured by Walter Kidde & Company Inc. are designed for normal flammable liquid hazards of up to 6000 cubic feet. This new method of merchandising carbon dioxide systems eliminates custom engineering, production and installation costs.

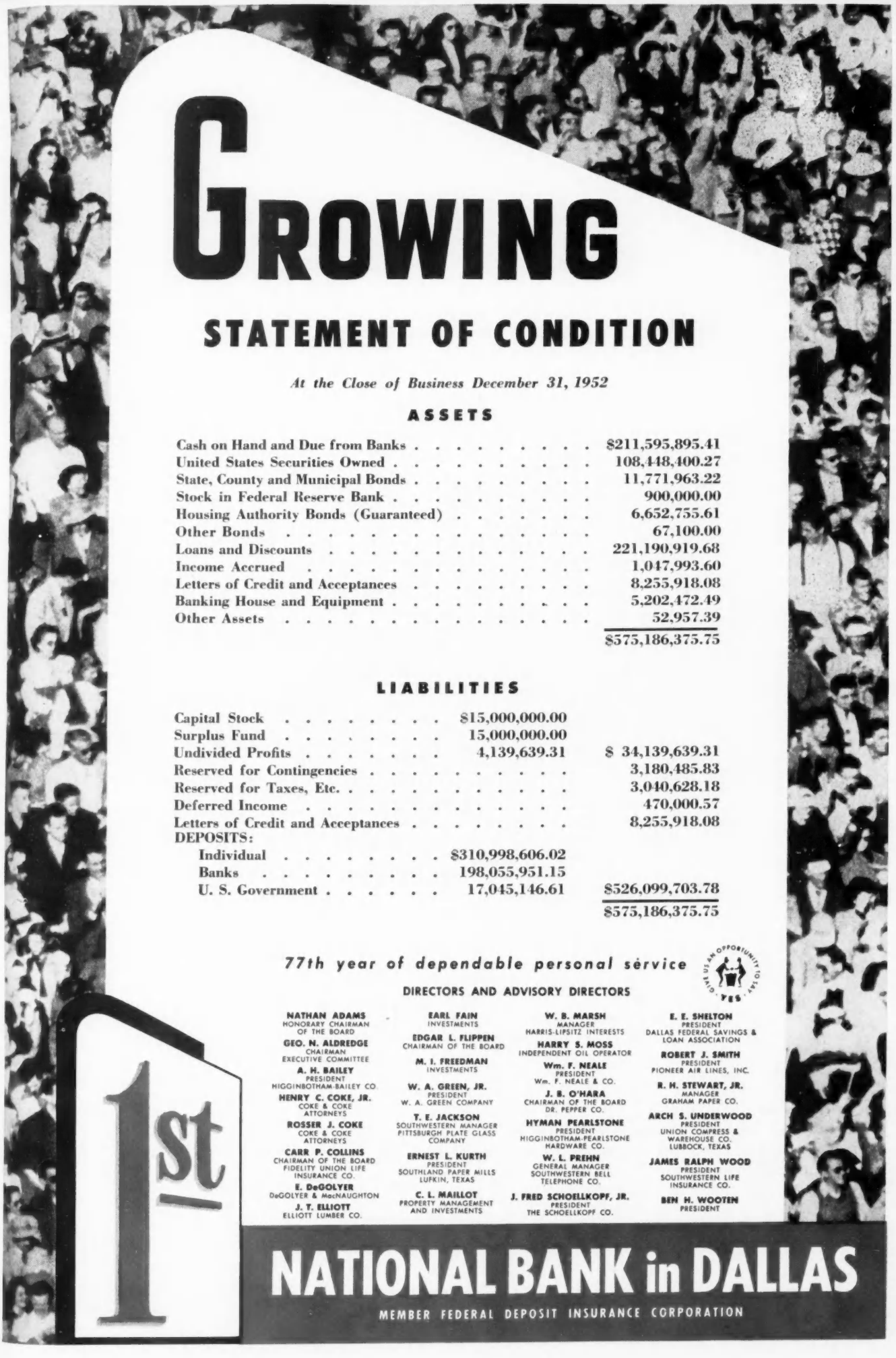
Circle No. 30 on Postcard

Pressure Regulator

Minneapolis-Honeywell Regulator Company has added a combination pressure regulator and filter to its products. This instrument provides a single, compact unit that contains the functions of a dependable reducing-relief valve and a filtering arrangement for line service.

Circle No. 31 on Postcard

Save time! Keep informed! Circle numbers on postcard, page 71



GROWING

STATEMENT OF CONDITION

At the Close of Business December 31, 1952

ASSETS

Cash on Hand and Due from Banks	$211,595,895.41
United States Securities Owned	108,448,400.27
State, County and Municipal Bonds	11,771,963.22
Stock in Federal Reserve Bank	900,000.00
Housing Authority Bonds (Guaranteed)	6,652,755.61
Other Bonds	67,100.00
Loans and Discounts	221,190,919.68
Income Accrued	1,047,993.60
Letters of Credit and Acceptances	8,255,918.08
Banking House and Equipment	5,202,472.49
Other Assets	52,957.39
	$575,186,375.75

LIABILITIES

Capital Stock	$15,000,000.00	
Surplus Fund	15,000,000.00	
Undivided Profits	4,139,639.31	$ 34,139,639.31
Reserved for Contingencies		3,180,485.83
Reserved for Taxes, Etc.		3,040,628.18
Deferred Income		470,000.57
Letters of Credit and Acceptances		8,255,918.08
DEPOSITS:		
Individual	$310,998,606.02	
Banks	198,055,951.15	
U. S. Government	17,045,146.61	$526,099,703.78
		$575,186,375.75

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PRESIDENT

1st

NATIONAL BANK in DALLAS

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Save time! Keep informed! Circle numbers on postcard, page 71, corresponding to items on this page.

Industrial Steam Trap

A new bulletin on W. H. Nicholson & Company's industrial steam trap is available. This Type D thermostatic bellows steam trap was only recently added to the Nicholson line and is smaller in size and capacity than earlier types. It embodies generous sized hexagon shanks to accommodate standard wrenches. The hardened stainless steel valve and seat are removable.

Circle No. 32 on Postcard

Vertical Pump

Construction features of Allis-Chalmers Manufacturing Company's small vertical pumps for sidewall or submerged mounting are described in a new bulletin. Sidewall-mounted units are the mechanical-seal, closed-impeller pump, the mechanical-seal, open-impeller pump, and the mounted, sealless, open-impeller pump. Submerged-mounted units are the sealless, open-impeller pump, and the sealless, closed-impeller pump.

Circle No. 33 on Postcard

Industrial V-Belts

The "Texrope" gromet V-belt is described in a bulletin released by Allis-Chalmers Manufacturing Company. Allis-Chalmers reports this belt is the only one made without a splice. It is claimed to be cooler running, shock absorbent, has one-tenth the shrinkage and one-third the stretch of other belts, offers less slip and more grip, and is stronger.

Circle No. 34 on Postcard

Packing Products

A new bulletin was issued recently by the Packing Division of Raybestos-Manhattan, Inc., featuring R/M Teflon Products. Gaskets, rings in irregular shapes, sheets, tubes, rods, tape, braided and plastic packings, packings for stuffing boxes and valve stems, and Vee-Flex packing rings are described.

Circle No. 35 on Postcard

Plastic Pipe

A brochure covering plastic pipe has been issued by the Plastic Products Division of Triangle Conduit & Cable Company, Inc. It contains information on flexible, semi-rigid, rig high impact and rigid polyvinyl chloride pipe.

Circle No. 36 on Postcard

Compressor

A new M-Line compressor bulletin has been released by The Cooper-Bessemer Corporation. This engineering-type catalog provides basic application data with design specifications on the complete line of reciprocating compressors from 100 to 5000 horsepower. The compressors are powered by electric motors or internal combustion engines. Multi-stage and multi-cylinder units are included in the material.

Circle No. 37 on Postcard

Pipe Repair Clamps

A bulletin issued by Adams Pipe Repair Products announces that malleable iron castings in their line of Stauffer pipe repair clamps are now furnished with two coats of powdered stainless steel in plastic suspension. Stainless steel bands also assure longer life. Stauffer clamps feature an exclusive slotted lug which enables the user to simply drop the bolt through the slot and tighten.

Circle No. 38 on Postcard

Tachometer

A new bulletin describing its full line of recording and indicating electric tachometers has been issued by The Bristol Company. Instruments described include models for measuring speed of rotation or travel, processing time, speed ratios, sum or difference of speeds and average of speeds. The recently perfected Dynamaster Recording Tachometers are featured.

Circle No. 39 on Postcard

Gravity Correction

The Stephens Gravity Correction Tables, in whole numbers and tenths of degrees, has been published by Ross-Martin Company in book and chart form. No interpolation is needed for the tables which are arranged so that locating the observed gravity and temperature automatically gives the final corrected gravity. The chart is made for whole numbers only. The Tenths book provides the same easel-cover as the Whole Number book, but differs mainly in featuring tables with gravities corrected to the nearest tenth of a degree.

Circle No. 40 on Postcard

Well Packer

The Guiberson Corporation has issued information on its Hydro-Pak Type HS Packer for pack-off and holding power in pressure operations. The packer is recommended by the company for use in wells of any depth in acidizing, formation fracture or other processes requiring tubing pressure in excess of casing pressure.

Circle No. 41 on Postcard

Laboratory Stirrer

Technical data sheets on Eberbach Corporation's Hollow Spindle stirrer are now available. This 1550 rpm. laboratory stirrer features the Eberbach "hollow spindle" which enables the user to raise or lower the propeller quickly. The propellers are of glass, metal or plastic, and the shaft measures from 7/32 to 5/16 inches in diameter.

Circle No. 42 on Postcard

Flame Plating

Flame plating services offered by Linde Air Products Company, a division of Union Carbide and Carbon Corporation, are discussed in this new booklet. Applications of undiluted coatings of powdered metals are described in regard to coating properties and results of wear tests.

Circle No. 43 on Postcard

Pennsylvanian Cross Sections Of Central Oklahoma

Three years of study completed by special committee of Shawnee Geological Society.

THE ACCOMPANYING cross sections are the culmination of approximately three years of study of well cuttings and work with electrical logs by research committees of the Shawnee Geological Society. It is unfortunate that it was impossible to agree with the surface correlations in all respects, but it is believed that all correlations as shown on the cross sections are valid and will serve to assist the surface geologists in resolving some of the questions they encounter. These cross sections are designed to be the key to present subsurface geology in the region they represent. New geological names which are desired to be used in reporting formations in wells are written in slanting letters. Geological terms for formations not in controversy are written in straight letters. Several common subsurface terms, such as "Big lime," are not used on the cross sections because the present usage is confused and it is desired to discourage continuation of the terms.

The correlation of the following horizons as used on the cross sections are different than the general conceptions: (1) Belle City is not equivalent to Dewey; (2) Francis is in the Ochelata, not the Skiatook; (3) Seminole is not equivalent to Jones-Cleveland; (4) Wewoka is not equivalent to Fort Scott; (5) Verdigris is not equivalent to Senora lime; (6) Skinner is not equivalent to Senora sand; (7) the Musselem sand is in the Skiatook, not in the Ochelata. Two new formation names are used on the cross sections, Eaton and Oswego, for divisions in the Marmaton. These terms are used for the lack of substitutes for conditions which need names.

The Pennsylvanian sediments of central Oklahoma are perhaps the best for careful study because of the accumulation of accurate information and because of the key nature of the section. It falls naturally into the series divisions of the surrounding Mid-Continent area: Virgil, Missouri, and Des Moines. The north-south cross section presented here runs from T29N, R3E to T8N, R5E. This gives a complete traverse from the Kansas line to the typical Seminole section. The east-west traverse runs through T19N, R1E to T19N, R8E. The purpose of this section is to check the correlations on the north-south section and to carry them nearer to the outcrops and basinward to show the regional changes.

The correlations, as shown on the cross sections, are primarily from electrical logs, but sample studies have been made to verify unconformities and questionable points. No attempt has been made to correlate the subsurface beds with the outcrop section for various reasons. In general, there is a great similarity between the subsurface and the established facts of the surface.

Virgil Series: The Brownville limestone is the topmost member of the Virgil Series, while the base of it is the unconformity at the top of the Missouri. The upper marker is unproved on the cross sections, but the lower marker is easily established in samples by the conglomeratic nature of the sands which lie above the unconformity. In the absence of the sands, the unconformity can be determined by the character of the shales as well as by projection. The Virgil contains the Wabaunsee, Shawnee and Douglas groups. The Shawnee group contains the Pawhuska and Elgin formations. The Douglas is equivalent to the Nelagony formation, which is practically the same as the subsurface Tonkawa.

Missouri Series: The Missouri Series consists of two groups, the Ochelata and the Skiatook. The Series is limited at the top and bottom by unconformities and the groups are separated by one.

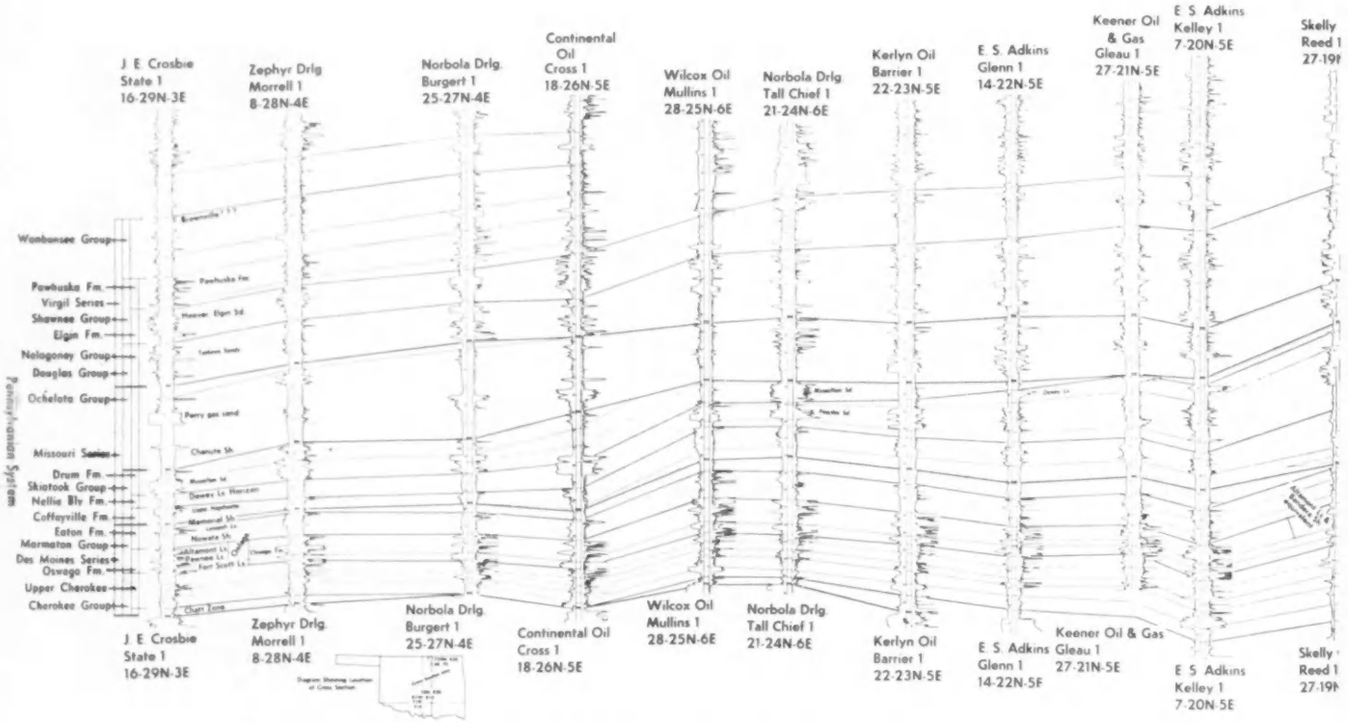
OCHELATA GROUP: The Ochelata contains the Belle City and its equivalents at the top, with other limestone and sand stringers near the base. The sand lying below the Belle City is partially equivalent to the Francis of the Seminole area, but the term Francis is applied to it since the lower Francis is in the Skiatook group and has other names. The study of the Ochelata group has been most extensive and there is hardly a doubt of the validity of the present interpretation.

SKIATOOK GROUP: The Skiatook lies below the Ochelata unconformably. It thickens rapidly from north to south with the result that successively older beds are beveled from north to south. This is clearly shown on the cross sections. This group contains the equivalents of the Kansas City group, but is not lithologically the same. It consists of three formations, the Drum, Nellie Bly and the Coffeyville.

DRUM FORMATIONS: The Drum formation is the portion of section above the Dewey limestone, containing a number of limestone and sandstone beds. It terminates southward by unconformity.

NELLIE BLY FORMATION: The Nellie Bly contains the Dewey and other members down to the upper Hogshooter limestone. The Dewey limestone is a very prominent marker. It is terminated southward by unconformity. The Peoples sand lies below the Dewey and above the upper Hogshooter. It also terminates southward by unconformity.

COFFEYVILLE FORMATIONS: The Coffeyville formation contains the Hogshooter limestones, Layton sandstones, Checkerboard limestones and sandstones and the Wewoka, Holdenville and Seminole members of the



Shawnee Geological Society—north-south cross section of Pennsylvanian.

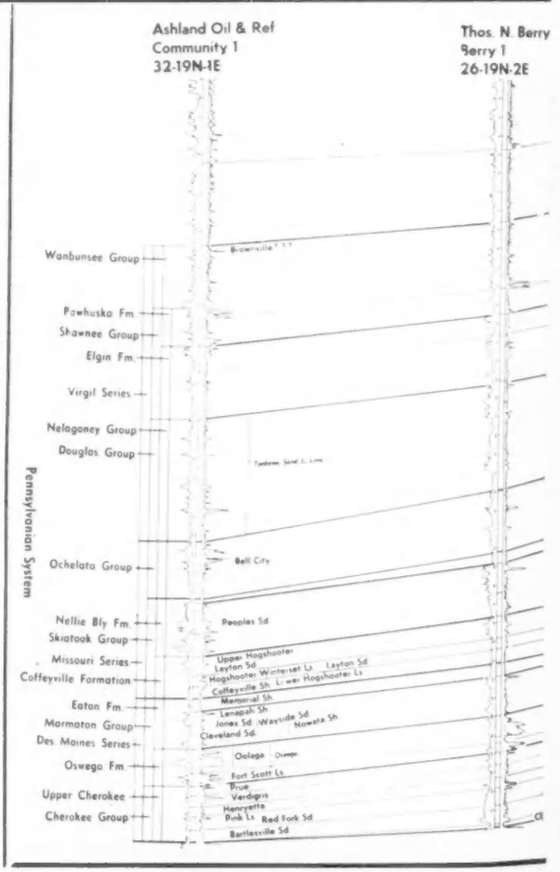
Coffeyville shale. Hogshooter and Checkerboard limestones of the surface become prominent south of T18N. The surface names are applied to the latter two formations. It appears that the middle Hogshooter limestone of the subsurface is the Hogshooter of the surface. The Checkerboard disappears to the northwest by outlap on the Memorial shale. This unconformity marks the base of the Missouri Series. The same unconformity is indicated on the state geological map by the overlap of the Coffeyville on the Lenapah limestone in T25N, R15E.

Des Moines Series: The Des Moines Series is terminated at the top by unconformity and in the area of these cross sections is generally considered to extend downward to the Mississippi limestone.

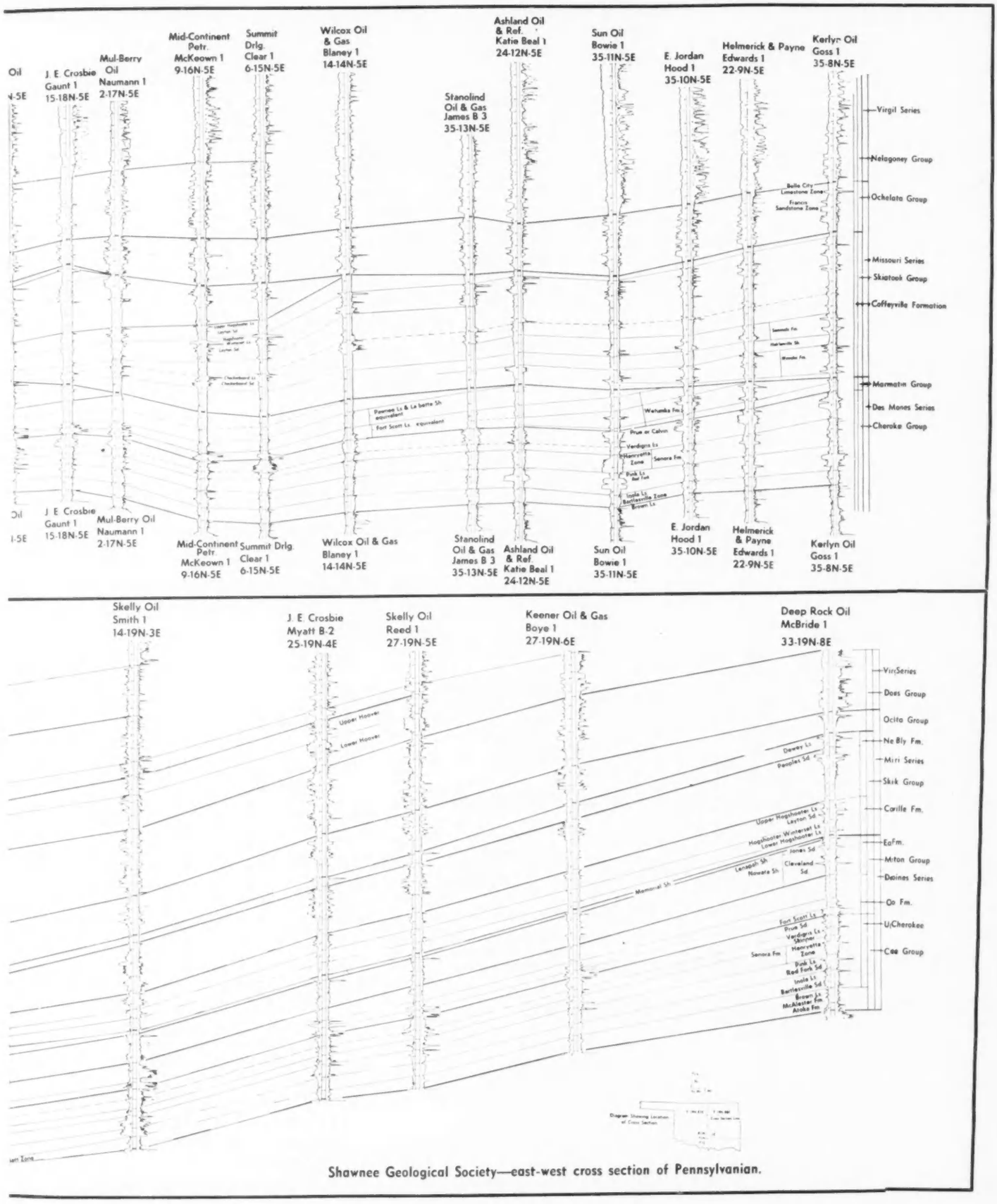
The Des Moines Series is divided into the Marmaton and the Cherokee groups. The Marmaton contains the Memorial shale, the Lenapah limestone, the Nowata shale with the Jones-Cleveland and Wayside sands. This is considered to be a formation which is called "Eaton" on the cross sections from the town of that name in Oklahoma. The lower Marmaton, or Oswego, formation contains the Altamount limestone, the Bandera shale, the Pawnee limestone, the Labette shale (with the Peru sand), and the Fort Scott limestone as well as all facies equivalents of these formations. The Cherokee group contains the Prue sandstone, the Verdigris limestone, the Skinner sandstone, the Henryetta coal zone, the Senora limestone and sandstone, the Pink limestone, the Red Fork sandstone, the Inola limestone, the Bartlesville sandstone and the chatt zone (in which the Burgess sandstone is found) as well as all facies equivalent. The correlations of the Cherokee units are quite clear and appear very definite on the cross sections. Unconformities of overlapping nature are probably present, but are not of any great regional importance.

There is one point of great difference occurring on these cross sections between this interpretation and the general conception. This is the distinction of the Checkerboard from the Lenapah limestone with the consequent disassociation of the Jones-Cleveland sands from the Seminole formation. This difference is clearly shown on the cross sections and the state geological map establishes the fact that the Checkerboard and the Lenapah are two different formations, since both are present in T25N, R15E. Consequently, the Seminole formation cannot be the Jones-Cleveland equivalents.

The cross sections, as laid out, clarify the geology of this important



area. Some questions naturally cannot be answered from these two sections, but it is felt that any question can be examined in the light of basic facts



Shawnee Geological Society—east-west cross section of Pennsylvanian.

and can probably be solved by additional cross sections to the areas of doubt. The Shawnee Geological Society is satisfied that all essential points on these cross sections are the correct interpretations and until new evidence is found to disprove them, wish to use the sections as established for the standard of the area t cover.

ACKNOWLEDGMENT

Published in WORLD OIL ermission of Shawnee Geological Society.

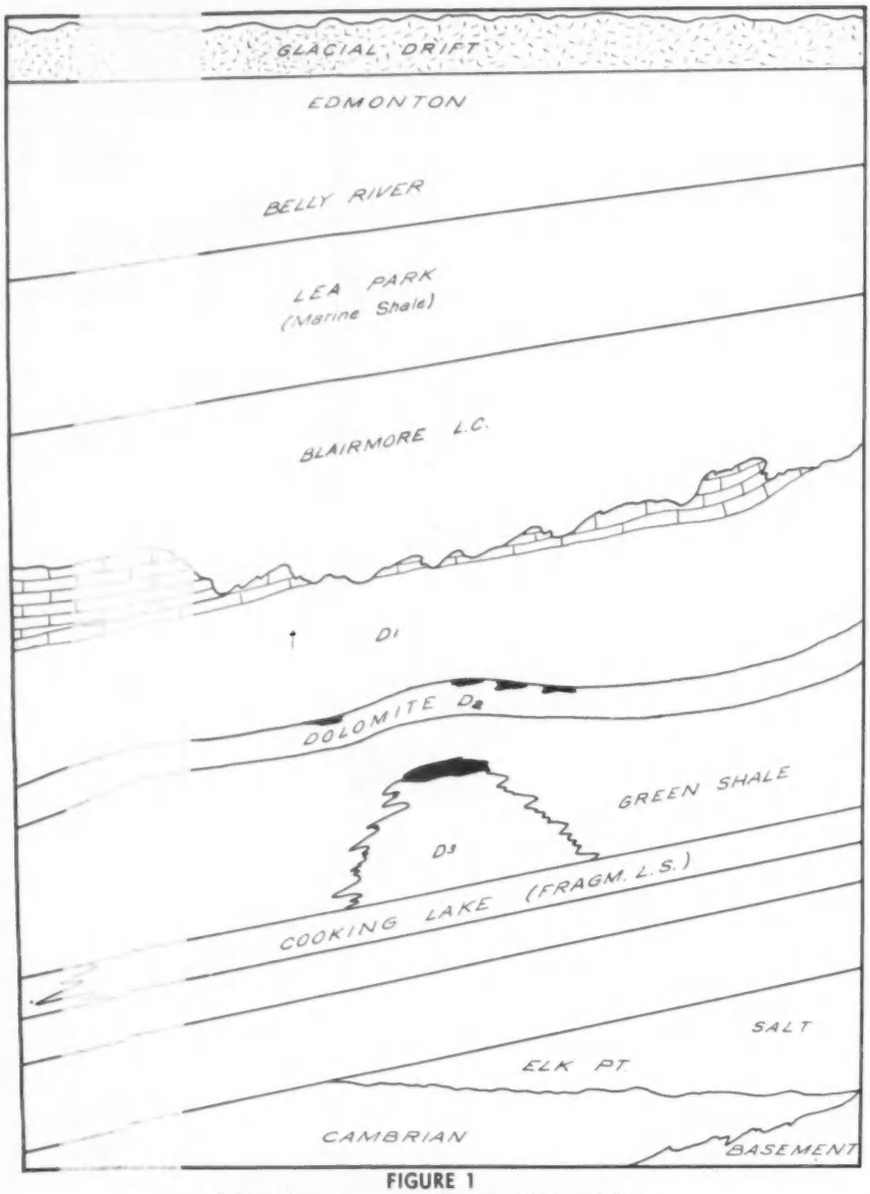


FIGURE 1
Schematic cross-section through Alberta plains.

Here's how certain variations of standard field techniques helped in the . . .

Interpretation of Seismic Data In Locating Reefs in Alberta

By P. L. FELTZ,
Chief Geophysicist
Century Physical Corporation, Tulsa, Okla.

THE PRESENCE AND location of a number of the most important producing fields in the Province of Alberta is directly related to the presence of Devonian reef growths. It is understandable, therefore, that current exploration programs in Alberta should place increased emphasis upon the location of more reefs under the vast plains of the province.

Much of the credit for mapping Devonian reefs, several of which have subsequently produced oil and/or gas, properly belongs to the seismologist and to his painstaking interpretation of seismic data in the light of available geological evidence. It is generally recognized that, at least for the present, the standard seismic instruments and techniques so widely used in other areas are also the most suitable tools to employ in the search for deep-seated Devonian reefs in Alberta.

The effective application of the seismograph method in the elucidation of the specific problems encountered within a particular area, however, often involves the introduction of certain variations of standard field and interpretation techniques. Such modifications, which are necessary in order to increase the resolving power of the seismograph, have been introduced in Alberta, and it is with their description and application that this paper principally is concerned.

Method of Approach. It is obvious that the problem of locating Devonian reefs in Alberta would be relatively simple if good and continuous reflections, originating from one or more horizons within the Devonian section, were obtainable. Unfortunately, this is not true, especially in areas where reef masses are present. In general it can be said that, perhaps with the exception of D_1 reflections in certain areas, reflections from the Devonian section are poor or non-existent; and in this fact lies the principal difficulty in interpreting seismic records obtained in connection with reef prospecting in Alberta.

In order to overcome this difficulty, the seismologist must resort to modification of his field and interpretation techniques.

Field Technique. It is obvious from the above discussion that every effort should be made in the field to "bring in" as much Devonian information as possible on the seismic record. This may be accomplished by varying the filter setting, depth and amount of explosive charge, AVC, recording level and geophone spread length and layout. Each prospect has its own peculiarities and only by thorough experimentation in the field can the optimum instrument settings and shooting procedures be established.

It has been observed that, of the variables mentioned above, changes in shot depth and in AVC and recording levels appear to exercise the greatest effect upon the quality and quantity of the information recorded at the Devonian level, and contribute most to securing additional Devonian informa-

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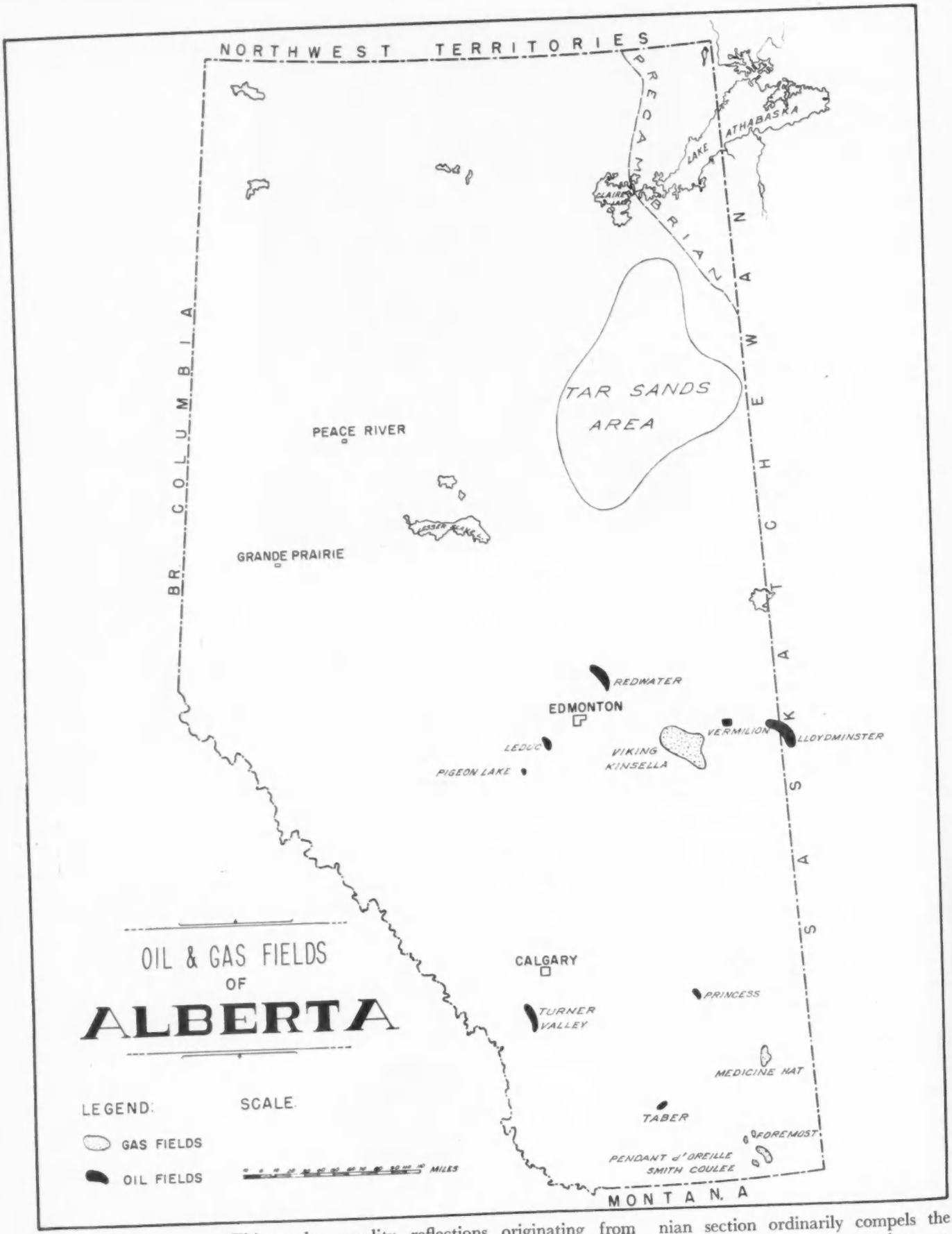
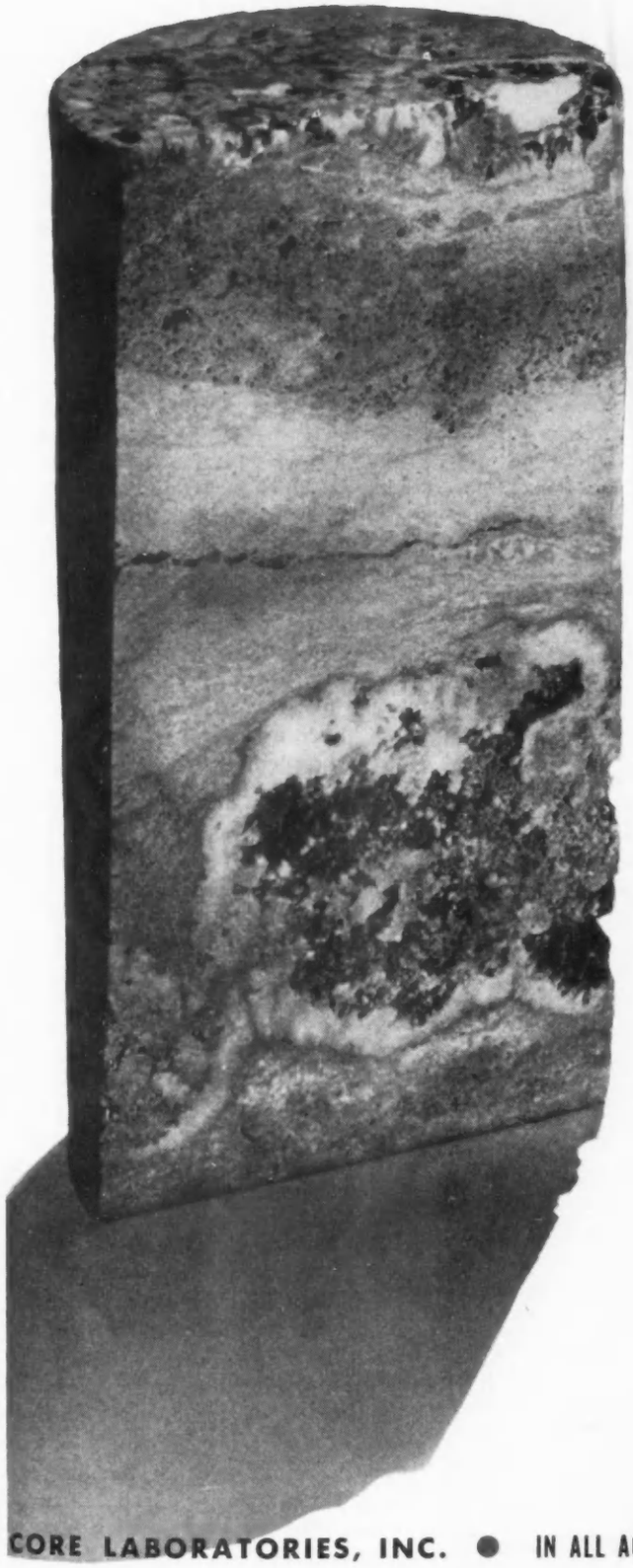


tion on the seismogram. This result, however, may be achieved at the expense of post- and pre-Devonian reflection quality. Additional records may then have to be shot to obtain better quality reflections originating from horizons other than the Devonian.

Interpretation Technique. The lack of reliable reflections from the Devonian section ordinarily compels the seismologist either to ignore that portion of the seismogram equivalent to the Devonian section, or to force Devonian picks on the basis of constant



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interval between Lower Cretaceous-Devonian and/or Devonian-Anhydrite reflections. Neither of these procedures will result in true interpretation. With the stratigraphic cross-section of a typical reef area in mind, it is evident that the seismologist does not accomplish much by forcing his picks on the basis of interval (See Figure 1). By ignoring the Devonian reflections, on the other hand, no effort is made to attack the problem.

When such records are studied carefully, it will be noticed that one or more of the following conditions exist in that part of the record which corresponds to the Devonian section:

- Phasing and splitting of reflections.
- Abnormal step-out.
- Appearance and disappearance of reflections.

In addition, abnormal reflections which appear earlier or later than the Devonian energy may exist. The presence or absence of such conditions often provides clues to the probable location of reef growths. This is only possible, however, when individual records are studied thoroughly and analytically. They must be studied much as an artist would study a painting. They should be carefully analyzed and should never be regarded simply as links which exist for the sole purpose of carrying a certain number of reflections from one profile to another.

Phasing and splitting of reflections may be associated with the convergence or even pinching out of formation against the reef mass. Abnormal step-outs indicating steep dips should also be picked and the dip should be computed and migrated if necessary. In most cases dips, when migrated, will be placed in the Devonian section.

The appearance and disappearance of Devonian reflections is of indirect importance. An attempt has been made to delineate areas where Devonian reflections were non-existent. Although the accumulated information is not sufficient at present to draw a final conclusion, there is a definite suggestion that areas where Devonian reflections are very poor or absent but where reflections other than the Devonian are good, correspond to areas where the seismic Cretaceous maps show highs, or to areas where reefs are known to exist.

Abnormal line-ups with unusually large step-out are occasionally encountered in a few continuous spreads. In at least one case in which a large reef mass was known to exist, the interpretation indicated that the abnormal event recorded was a refracted-reflection associated with the sides of the reef mass. Once such abnormal occurrences are detected in a given area, their use may become very effective in the establishment of a suitable field technique to determine the periphery of a reef. The problem in this connection would be to determine the distance of the shot point relative to the limits of the suspected reef.

In certain areas in Alberta, seismograms present suggested evidence of Pre-Devonian faulting. It has been argued that possible structural relations exist between such faults and reef building. Therefore, by indicating possibilities of Pre-Devonian faulting the seismologist may present to the geologist information which may enable him to reach important conclusions. Naturally, the existence of only one of the criteria discussed above cannot be accepted as sufficient basis for drawing a final conclusion. The combination of more than one of these criteria, however, coupled with the evidence provided by a Post-Devonian (generally Lower Cretaceous) structural map and all available isopach information, may provide the necessary data for the determination of the location of a reef mass.

Effect of Paleozoic Unconformity. It is recognized that similar manifestations as discussed above and associated with reef building may originate from sources other than reefing. The Paleozoic erosional surface is the most important of such sources. In the southeastern portion of the Albertan plains where the Mississippian topography is of the "early youth" stage, seismic records will exhibit characteristics such as phasing and splitting of reflections, abnormal step-out, appearance and disappearance of reflections, as well as abnormal reflection originating from the Paleozoic topographic features.

The influence of these features on seismic interpretation is very serious. Velocity variations caused by the Paleo-erosion surface, coupled with carrying a forced constant interval, may produce pseudo-structures in Devonian and lower depths. To prevent this, time corrections utilizing interval velocities below the Banff formation are used, and horizons are mapped on the basis of depth.

Isopach Maps. A great deal of importance is attached to seismic isopach maps in an effort to detect reefing. Such isopach maps are ordinarily based on corrected time differences between a Lower Cretaceous and Devonian horizons, also a similar isopach between the Devonian and a deeper formation. Time isopach between the Cretaceous and the top of the Devonian section may be considered as reliable. The same, however, cannot be said about the Devonian and a deeper horizon isopach, because of existing velocity variations. When and if velocity surveys and velocity gradients are available, such isopachs could be prepared on the basis of depth, in which case they will certainly have greater significance.

Conclusion. It is believed, accordingly, that in the portion of a record corresponding to the Devonian section, there lies a wealth of information, often inconspicuous, but nonetheless of inestimable value in the solution of the problem of reef location. This portion of the record should be studied carefully and somewhat independently of the earlier and later reflection events. Necessary precaution must be taken, however, to insure that anomalous events on the record do not originate from any other source than reef masses.

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About the Author

PERTIV I. BEDIZ is chief geophysicist of Century Geophysical Corporation. He attended the University of Istanbul and received his Master of Geophysical Engineering degree from Colorado School of Mines, subsequently attending M.I.T., where he did graduate work toward a doctorate degree. Bediz has had 11 years' seismic experience in many of the major oil provinces of the U. S., Canada and Turkey.

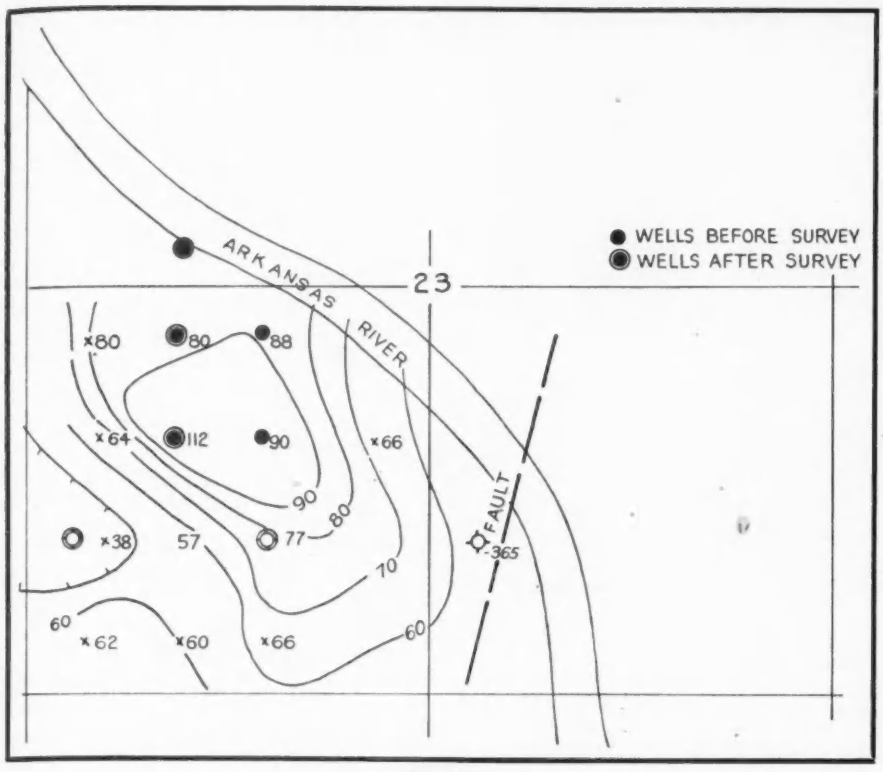


FIGURE 1
28N-3E, Kay County, Oklahoma.

Surface Electrical Method Detects Oil Directly

Here's another tool for the geologist in his search for oil. This system employs the principle of electromagnetism and measures resistivity of petroleum 'in situ' from the surface.

By H. M. EVJEN
Elflex Survey Company,
Wichita, Kan.

UNTIL RECENTLY, geologists have sought oil largely by mapping structural traps favorable for petroleum accumulation, using plane table and alidade to recognize surface structures and geophysical tools, such as the seismograph, gravimeter, or magnetometer, to detect subsurface structures. Numerous successes have been scored, and many favorable structural traps doubtless remain undiscovered, although the number which can be easily and accurately mapped with conventional tools naturally is decreasing.

At best, however, the mapping of structure is one step removed from the ultimate purpose of exploration, which is to find petroleum. Not only do dry structures exist, but the traps are sometimes so ill defined structurally as to be very difficult to map with conventional tools. Some favorable traps are not associated with structure at all, but are lithological or stratigraphic in nature. Therefore, a tool has been designed to detect petroleum directly, and it should be a very welcome addition to the art of exploration.

The new technique is an electromagnetic method. It indicates the presence of oil by measuring the resistivity of subsurface formations from the surface of the ground. Although the method has its limitations, it has proved its value in field application and is offered as an additional tool for geologists in their search for oil. The method will be here explained, and results of surveys made in Kansas and Oklahoma will be given.

An outstanding physical property of petroleum, compared with other fluids commonly found in the ground, is its high electrical resistivity. This is taken advantage of, in the appraisal of the production possibilities of a hole drilled, by means of electric well logging. An electric current, passed through the ground, is conducted almost exclusively by the watery solution, or electrolyte, commonly found in the pore spaces. When this electrolyte is replaced locally by petroleum it results in an enormous increase in electrical resistivity, which can be detected even in a hole disturbed by drilling. This is done in spite of the fact that one such hole can give only the variation in resistivity up and down the section, where the time

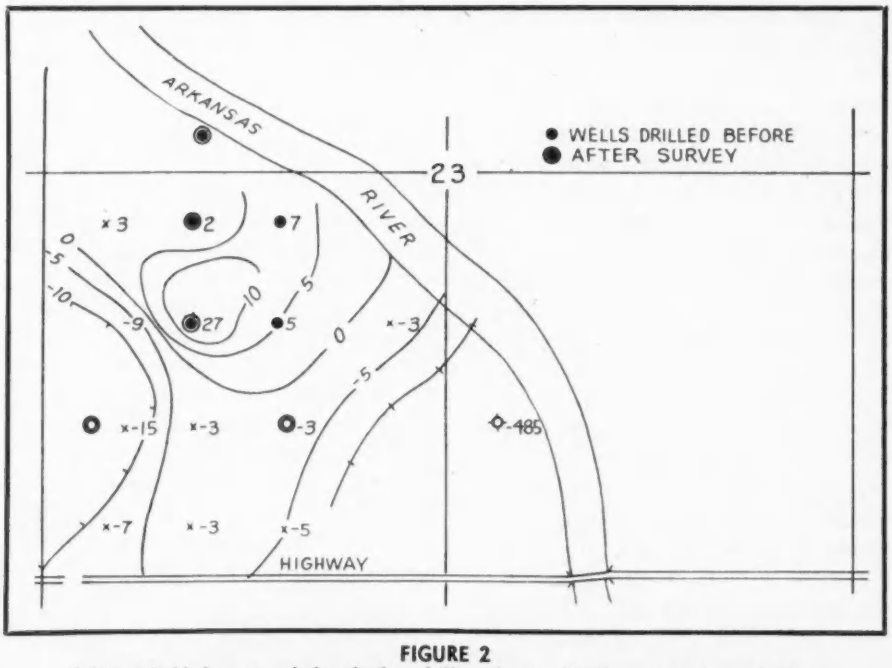


FIGURE 2
Original field data as tabulated after drilling four wells. Zero controls production.

factor and the "rock background" varies. If the resistivity of one and the same formation could be traced laterally, then local increases in resistivity would have greater significance.

But can the resistivity of a formation be measured from the surface of the ground, without the drilling of expensive core holes?

This is where a scientist well versed in the theory of electromagnetism is required to give the answer. Most have only a faint idea how radio waves travel through the atmosphere or light waves from the sun, although those problems are very much simpler. When we try to set up an electromagnetic wave in a conducting medium like the ground, we have to contend with absorption and dispersion, and this tends to complicate the problem. It is not insolvable, however, and why it was not solved a long time ago may be explained by the fact that no specific demand for its solution existed. The problem has now been solved both academically and in a practical manner.

In order to get an appreciable penetration of the electromagnetic wave through the ground, it is necessary to use extremely low frequencies, of the order of 0 to 10 cycles per second. The reason for this is that an electromagnetic wave, in the ground, is almost completely absorbed in a distance of a single wavelength. The quicker the wave oscillates, that is, the higher its frequency, the more quickly it is absorbed. Therefore it is necessary to use a frequency so low that the depth to be explored is around one-quarter of the wavelength of the electromagnetic wave used. This means that the frequency has to be as low as stated, when the low average resistivity of the ground is considered.

A second conclusion is that an electromagnetic wave travels through the ground with a speed which is surprisingly low, compared with the velocity of light and radio waves through the atmosphere. In fact, for the low frequencies specified, the speed is of the same order of magnitude as that of seismic waves. Moreover, the speed depends on frequency, and is reduced as the frequency is lowered. At zero frequency, the field becomes static, and loses the characteristics of a propagated wave.

It was long thought that absorption would limit penetration too much, and would stand in the way of the employment of electromagnetic waves in the ground. Everyday experiences with light and radio waves seemed to bear this out. At the same time, it was realized that by reducing the frequency to zero, that is, by using direct current, all absorption disappeared, and the penetration was theoretically unlimited. So direct current was used, or at any rate, it was believed that the frequency employed was low enough so that the potential theory of DC could be employed, which, incidentally, would be the same as used in gravimeter or magnetometer work.

To improve the accuracy of the work, and for other practical reasons, frequencies as high as 50 cycles per second were used in some of this early work; and it may not have been realized that such frequencies, in the ground, must be considered as ultra-high, and that DC theory was definitely not applicable. Where DC was actually used, other sources of confusion were at once apparent. With direct current, the field is static. It may be considered as the limiting case of an electromagnetic wave propagated with zero velocity. As a result, responses from various depths, so to speak, arrive simultaneously.

In seismic work, it is easy to separate shallow from deep reflections, by virtue of the time of arrival. Unwanted "shallow events" can be easily weeded out by the use of a suppressor, cutting out early arrivals. This cannot be done in truly DC work, and as a result, the usually preponderant shallow responses obscure the observations. By a process analogous to the old time-distance measurements in refraction shooting, it is theoretically possible, but not practically feasible, to weed out the shallow obscurity and get some measure of resolution. This has been tried many times, but always with discouraging results.

In the new technique, which now will be briefly outlined, shallow responses are eliminated by a process which is analogous to the use of a suppressor in seismic work. The current which is passed into the ground consists of pulses in alternating direction, with gaps between them. During these gaps, no current is passed through the energizing cables and electrodes. All measurements upon the ground are performed during these gaps. By so doing, one is assured that the impulse picked up and measured has spent an appreciable time travelling through the ground; that the bulk of it is conditioned by the deeper portions of the ground; and that most of the shallow and proximate obscurity is eliminated.

Time accepted theory yields the pattern according to which "reflections" from deep horizons are obtained. The depth of maximum response depends on:

- The average resistivity of the ground and
- The frequency of alternation of the commutated current used.

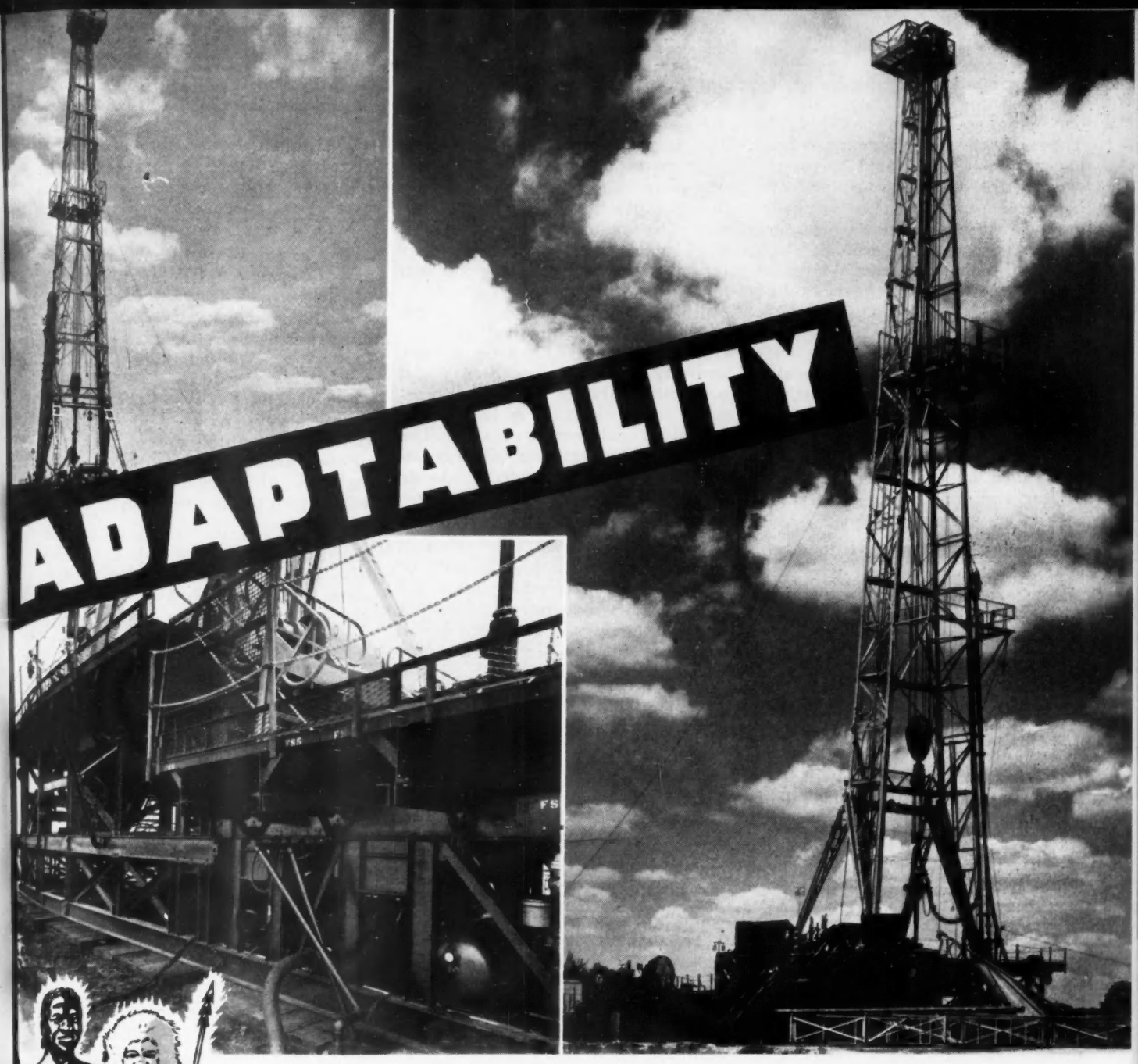
The former depends largely on the fluid contents of the pore spaces, and has had millions of years to equalize laterally, except where the normally present watery solution is replaced by other material. The latter may be varied at will, and thus affords a convenient means of concentrating attention on various depths.

The reflections from various depths do not stand out in as bold and sharp relief as could be desired. In other words, the resolving power of the method leaves much to be desired. By the aforesaid time accepted theory, it is possible to combine the readings obtained at various frequencies in such a way as to increase the resolving power. It is desirable, however, to keep these calculations as simple as possible, and to depend mainly on the directly observed quantities.

Theory shows that reflections should be expected from any interface

About the Author

DR. H. M. EVJEN was born in Oslo, Norway, where he received his primary education. He came to the U. S. in 1922 and entered Cornell University where he received his E.E. degree in 1926. He next enrolled at the California Institute of Technology and received his M.S. degree in 1927 and his Ph.D. in 1929 His first job in the oil industry was with Gulf Oil Corporation. Later he joined Shell Oil Company under assignment to prepare a text book on the interpretation of seismic data. After working with Shell on various geophysical assignments, in 1939 he became associated with Elflex Company, of which he is vice president.



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in the ground where the resistivity changes from one average value on one side to another on the other side. These reflections are superposed on a background which would be present even if the ground were perfectly homogeneous and uniform. The background depends on the *average* electrical properties of the ground, which have had millions of years to equalize laterally. At the low frequencies used in this work, it is not only relatively small, but also has been found to be remarkably constant over quite wide areas. Nevertheless, distinct anomalies in the observed quantity sometimes are observed. This has been found to be invariably true, for instance, over areas where production has been established by drilling, whether the drilling was done before or after the application of this technique.

Why should this be so? Is there any good and sound reason why anomalous readings should be obtained over production? The answer is yes. When the normally present ground waters are replaced by petroleum, the boundary between this formation, which now has acquired a very high resistivity, and the overburden, which remains unchanged, assumes the properties of a mirror, as we know it from our experiences with visible light. The low frequency electromagnetic wave which is set up in the ground is reflected by this mirror, and the anomaly which is observed is this reflection.

The amplitude of the reflection, or the magnitude of the anomaly, has been theoretically checked. It depends on a number of things. It depends on the average ground resistivity, the depth explored, and most important, the resistivity contrast of the reflecting horizon. When the depth to the reflecting horizon changes, as in the case of geological structure, this will sometimes give rise to an anomaly, reflecting the structure. The main cause of the observed anomalies, however, has been found to be changes in resistivity of a formation in the neighborhood of the depth of maximum response. Needless to say, this is quite independent of structure, so the method works equally well for lithological and stratigraphic traps.

Assuming that a positive anomaly has been observed, indicating that a formation within the ranges of depth under observation has locally an increased resistivity, this may be caused by a number of different things. It may be caused, for instance, by the intrusion of an igneous plug, which has a high resistivity, compared with the water-bearing sediments. In general, it may be caused by the local presence of any impervious rock, whose structure is such as to prevent the easy passage of an electric current. The important thing is that the local replacement of the normally present watery solution by petroleum invariably produces an increase in resistivity. It should be remembered, however, that the method gives no clue as to porosity. A good positive anomaly sometimes has been found over oil saturated impervious limestone, from which oil in commercial quantities could not be obtained. The insight and acumen of a skilled geologist are very much needed to decide doubtful cases.

To illustrate how often doubtful cases are apt to arise, some statistics from the state of Kansas will be quoted. A strip stretching some 250 miles NW-SE and covering 30 distinct and separate areas was surveyed with the new tool. In each of these, a hole was subsequently drilled. Sixteen good, positive anomalies were recorded. Eleven of these were drilled and had commercial production. Five of the 16 were drilled and had good shows but no commercial production, for the reason given above. In other words, judging by these statistics for Kansas, failure of a good, positive anomaly to give commercial production is apt to occur in slightly less than one-third of the cases.

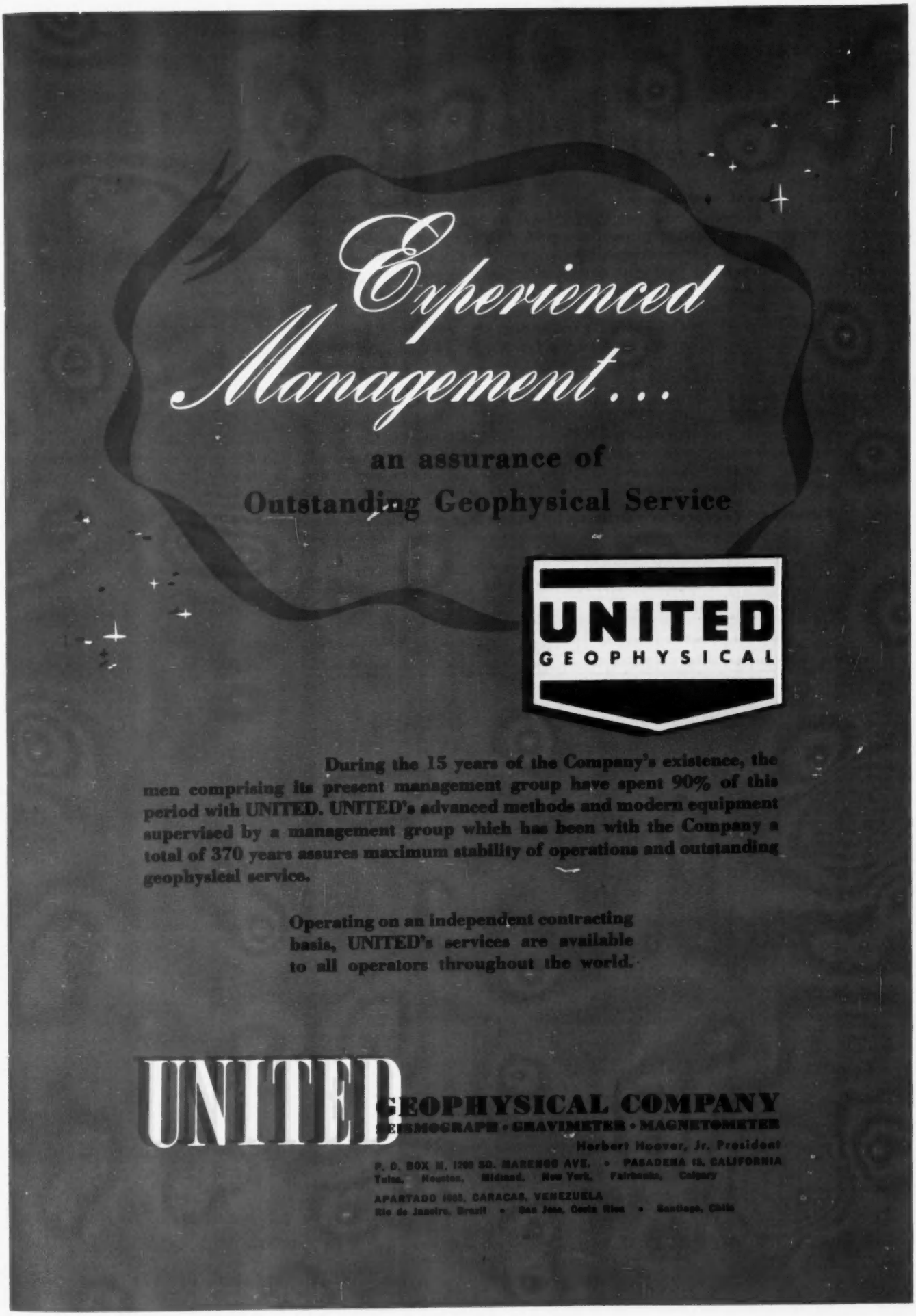
To complete the statistics, in 11 of the 30 areas, the anomaly was intermediate; nothing could be strongly recommended, nor could it be condemned. Of these, six were drilled and had good shows but no commercial production; five actually had commercial production when drilled at the best possible indicated location. The three remaining areas were negative as interpreted by this technique but nevertheless were drilled. All were dry holes.

To illustrate further the limitations of the new tool, the results from an area in Oklahoma will be given in detail. This job was done for Leo Fortier of Wichita, and one day was spent in the Newkirk Area, Kay County, Oklahoma, measuring 14 stations in Sec. 23, 28N, 3E, as shown in Figures 1 and 2. The work was done under very difficult working conditions, and the coverage left much to be desired. The area, at this time, had the two producers and one dry hole shown. Stations were measured at each of these and at 11 additional possible locations in the S. E. quarter of Section 23. Five holes have been drilled subsequent to this work, three at locations where stations had been measured, and one near enough so that a prognosis based on this station should be significant.

The impedance, substantially as observed, was contoured. A copy of the original map, as submitted, is shown in Figure 1. This map shows all producers within an 80 value contour; dry holes outside this contour. One dry hole will be seen to have been drilled subsequent to this work at a station having a value of 77. This station is right on the edge of the indicated prospect area. With this possible single exception, the prognosis in this area will be seen to have been perfect.

Figure 2 was submitted after all the holes shown had been drilled, and so adds nothing to an appraisal of the method in a statistical sense. It does illustrate, however, what can be done by a more careful analysis of the data, and by increasing the resolving power, so as to eliminate unwanted reflections. Whereas Figure 1 shows the impedance, substantially as observed at the highest measured frequency, Figure 2 shows a simple linear combination of the four impedances, measured at four different frequencies. This combination was designed so as to eliminate as much as possible in this area. It also was designed so as to make a zero contour control production, with positive values indicating a prospect, negative none. With the deeper, interfering reflection eliminated, the whole picture will be seen to have been shifted somewhat to the north northwest, and all producers and non-producers are correctly indicated. This illustrates well the importance of being able to focus attention on the most interesting depth. The data from which Figure 2 was computed were submitted to the operator at the time of the original survey, and he was invited to check the simple calculations.

It is hoped the information contained in this article will serve to illustrate the possible value of this new tool to the geologist. It is by no means the "philosopher's stone" for finding oil but a method based on scientific premises. It has its limitations but it also has proved its ability to assist in a better evaluation of a prospect in the increasingly difficult work of finding new petroliferous reserves.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Exploratory Drilling Sets New Record During 1952

A NEW all-time high mark in exploratory drilling was set in 1952, when wells of that category topped the 1951 record by the bare margin of 69 tests. The 1952 program remained in front of the previous year's activity throughout the year, but the steel-strike-caused pipe shortage began to take its toll around midyear, and the lead continued to fade. At the final gun, last year's exploratory wells totaled 11,051 which amounted to an increase of only 0.6 percent over the previous record of 10,982 drilled in 1951.

Although the year just passed saw a few more exploratory tests completed than did the previous period, it also saw slightly fewer successful ventures. In 1952, a total of 1970 tests proved to be commercial producers, and they amounted to 17.8 percent of the total drilled. A year earlier, 69 fewer drilling attempts provided nine more producing wells. Those 1979 successful wells amounted to 18 percent of the total completed.

Oil discoveries were not as numerous during the year just past, the count being 1284 compared with 1350 in 1951. The year's oil pool discoveries consisted of 984 new oil fields and 300 new pay horizons in older fields.

New distillate sources were even farther behind. The year's efforts were rewarded with 132 new distillate pools, 110 new fields and 22 new pay strata, while 223 new pools were recorded in the previous year. However, much of the deficit was made up by natural gas finds.

Summary of Results of Exploratory Drilling

ITEM	Dec., 1952	Nov., 1952	TWELVE MONTHS January-December 1952	1951	Percent Diff.
Oil Discoveries	94	126	1,284	1,350	— 4.9
New Fields	71	93	984	992	— 0.8
New Pays	23	33	300	358	— 16.2
Distillate Discoveries	8	8	132	223	— 40.8
New Fields	5	5	110	172	— 36.1
New Pays	3	3	22	51	— 56.9
Gas Discoveries	21	19	208	89	+133.7
New Fields	17	14	166	62	+167.7
New Pays	4	5	42	27	+ 55.6
Total Discoveries	123	153	1,624	1,662	— 2.3
Extensions to Fields	27	26	346	317	+ 9.1
Oil Fields	18	20	287	242	+ 18.6
Distillate Fields	5	2	15	55	— 72.7
Gas Fields	4	4	44	20	+120.0
Total Prod. Tests	150	179	1,970	1,979	— 0.5
Dry Holes	764	812	9,081	9,003	+ 0.9
Wildcats	737	791	8,809	8,552	+ 3.0
New Pays		1	12	40	— 70.0
Outposts	27	20	260	411	— 36.7
Total Expl'tory Tests	914	991	11,051	10,982	+ 0.6
Percent Productive	16.4	18.1	17.8	18.0	
Percent Dry	83.6	81.9	82.2	82.0	

Results of Exploratory Drilling in December and Twelve Months, 1952-1951, by Districts

State or District	MONTH OF DECEMBER, 1952														TWELVE MONTHS, 1952															
	Productive Tests										Unproductive Tests			Total Exploratory Tests	Productive Tests									Total Productive		Unproductive Tests			Total Dry		Total Exploratory Tests	
	New Fields			New Pays			Extensions			Total Productive					New Fields			New Pays			Extensions										
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas		Wildcats	New Pays	Outposts		Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas	12 Mo. 1952	12 Mo. 1951	Wildcats	New Pays	Outposts	12 Mo. 1952	12 Mo. 1951	12 Mo. 1952	12 Mo. 1951
Alabama				1						1	5			6	1		1	1						3	3	38			38	24	41	27
Arizona																										2			2	4	2	4
Arkansas	1			1						2	13		1	16	13		2	5		2	1			23	22	112		2	114	97	137	119
California	1			2			2			5	33		8	46	31	1	7	22			27		2	90	85	384	3	47	434	531	524	616
Colorado			1							1	23			24	11	1	7	3		3	2		1	28	17	240		2	242	137	270	154
Florida											2			2												9			9	4	9	4
Georgia																															
Idaho																													1		1
Illinois	3			1			2			6	32			38	25		1	25		3	51			105	109	592			592	746	697	855
Indiana	4			1			2			7	19			26	29		2	3			19			53	54	349		2	351	434	404	488
Kansas	8		1	1						10	78			88	124	1	15	8			1			149	181	889			889	840	1038	1021
Kentucky	1			1						2	17			19	27			2			4			33	47	135			135	212	168	259
Louisiana		1		1	1	1				4	35		2	41	33	27	6	16	6	2	3	3	2	98	91	386	1	5	392	376	490	467
North Louisiana							1			1	20		1	22	13	5	4	9	3	1	2		1	38	43	228		4	232	240	270	283
South Louisiana		1		1	1					3	15		1	19	20	22	2	7	3	1	1	3	1	60	48	158	1	1	160	136	220	184
Maryland																													1		1
Michigan	1						3			4	23			27	17		2	6		3	7		1	36	19	243			243	307	279	326
Mississippi	1			1						2	16			18	13	2		4		1	3			23	24	159		5	164	176	187	200
Missouri											1			1												17			17	7	17	7
Montana			1							1	12			13	7		2				2			11	8	85		2	87	58	98	66
Nebraska	1								2	3	7			10	11		3	1			2		2	19	23	120	1	2	123	122	142	145
Nevada											1			1												1			1	2	1	2
New Mexico	1		2							3	9			12	19	3	15	9	1	3	7			57	42	118	1	1	120	88	177	130
New York																														15		15
North Carolina																														3		3
North Dakota											3			3	5						5			10	2	21			21	9	31	11
Ohio											2			2			1				2		7	10	7	31			31	26	41	33
Oklahoma	11		3	1			3		1	19	62			81	99	9	15	33	2	1	43	1	6	209	172	739			739	681	948	853
Oregon																														3		3
Pennsylvania																									10	2			2	32	2	42
South Carolina																														1		1
South Dakota											2			2												7			7	3	7	3
Tennessee																									3				13		16
Texas	36	4	9	12	2	3	5	5	1	77	316		16	409	510	64	84	157	13	23	104	11	23	989	1018	3917	6	190	4113	3871	5102	4889
Dist. 1 S. Central							1			1	25			26	15	6	1	1		3	8		1	35	41	331		6	337	234	372	275
Dist. 2 Middle Gulf	1	1	1			1		1		5	26		2	33	22	18	12	8		1	9	4	8	82	104	281	1	16	298	262	380	366
Dist. 3 Upper Gulf	1		2	4	1		1	3	1	13	31		10	54	30	17	10	54	9	9	10	6	9	154	112	322		42	364	280	518	392
Dist. 4 L. Gulf-S.W.		3	4	5	1	2		1		16	29		2	47	35	14	33	21	3	7	7	1	4	125	140	384	3	13	400	415	525	555
Dist. 5 E. Central											12		1	13	4	2					1			7	23	126		3	129	148	136	171
Dist. 6 Northeast	1									1	14			15	7	2	1	7			2			19	26	129		2	131	106	150	132
Dist. 7-B N. Cent.	13		1	2						16	60			76	165	2	15	12	1	2	4			201	234	915		9	924	1002	1125	1236
Dist. 7-C W. Cent.	1						1			2	24			26	61	1	3	9		1	17			92	85	364		3	367	324	459	409
Dist. 8 West	3		1	1			1			6	28		1	35	60	2	2	21			32		1	118	106	391	1	6	398	377	516	483
Dist. 9 North	16						1			17	67			84	111		6	24			14			155	137	653	1	86	740	683	895	820
Dist. 10 Panhandle																	1							1	10	21		4	25	40	26	50
Utah	1						1			2	2			4	2					1	2			5	3	51			51	28	56	31
Virginia																									2				6		8
Washington																													1		1
West Virginia															1									1		3			3		4	
Iowa																													3		3
Wyoming	1									1	24			25	6	2	3	5			2			18	37	159		2	161	141	179	178
Total U. S.	71	5	17	23	3	4	18	5	4	150	737		27	914	984	110	166	300	22	42	287	15	44	1970	1979	8809	12	260	9081	9003	11,051	10,982

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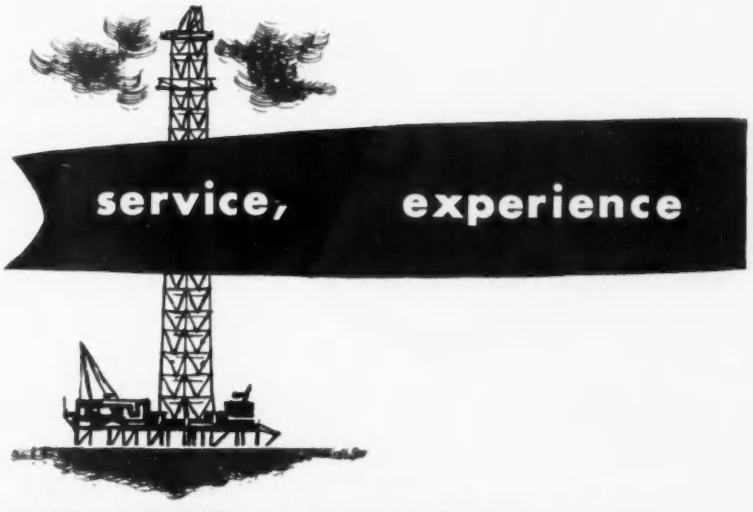

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U. S. Discoveries in December

ALABAMA—NEW OIL PAY

Escambia County, Pollard field. Gulf Refining Co.'s T. R. Miller Mill Co., Inc.'s 3, SE SE 12-1n-8e, flowed 33 barrels from Upper Tuscaloosa sand, Upper Cretaceous 5806-16 feet, ⅛-inch, 28.5-gravity, completed 12-13-52, TD 6339.

ARKANSAS—NEW OIL FIELD

Miller County, Doddridge field. W. G. Skelly's Dickson Heirs 1, in 36-19s-27w, flowed 132 barrels from Pettit lime, Lower Cretaceous 6828-40 feet, 36.8-gravity, completed 5-8-52, TD 11,076.

ARKANSAS—NEW OIL PAY

Nevada County, Falcon field. Sneed Bros.' A. L. Armstrong 1, C NW NW 10-15s-22w, pumped 41 barrels from Rodessa lime, Lower Cretaceous 2692-97 feet, 32-gravity, completed 12-18-52, TD 3363.

CALIFORNIA—NEW OIL FIELD

San Luis Obispo County. Oceanic Oil Co.'s "CCMO" B-1-2, SE NE 2-32s-22e, pumped 125 barrels from 2081-2222 feet, 15.3-gravity, completed 12-3-52, TD 2223.

CALIFORNIA—NEW OIL PAYS

Orange County, West Newport field. Sierra Oil Corp.'s Farnsworth 2, SE NW 12-6s-11w, pumped 210 barrels from Bolsa "B" sand 3425-3500 feet, 26-gravity, completed 11-26-52, TD 3501.

Ventura County, Basolo field. The Texas Co.'s Elkins 2, in 5-3n-19w, pumped 63 barrels from 4021-4183 and 2095-2390 feet, 27.3-gravity, completed 11-26-52, TD 4516.

CALIFORNIA—OIL FIELD EXTENSIONS

Kern County, Tunis Creek field. D. K. Partnership #3 Well 67-20, in 20-11n-18w, ½-mile north extension, pumped 39 barrels from 3710-20 feet, 16/64-inch, 33-gravity, completed 12-17-52, TD 3786.

Santa Barbara County, Careaga field. Western Gulf Oil Co.'s Careaga 2, NE NW 8-8n-33w, ¾-mile northeast extension, pumped 29 barrels from 4522-4975 feet, 36-gravity, completed 12-4-52, TD 4975.

COLORADO—NEW GAS FIELD

Kiowa County. Continental Oil Co.'s McClave 1, SE SE SE 11-20s-49w, flowed 0.4 million from Morrow sand, Pennsylvanian 4870-90 feet, completed 10-12-52, TD 5914.

ILLINOIS—NEW OIL FIELDS

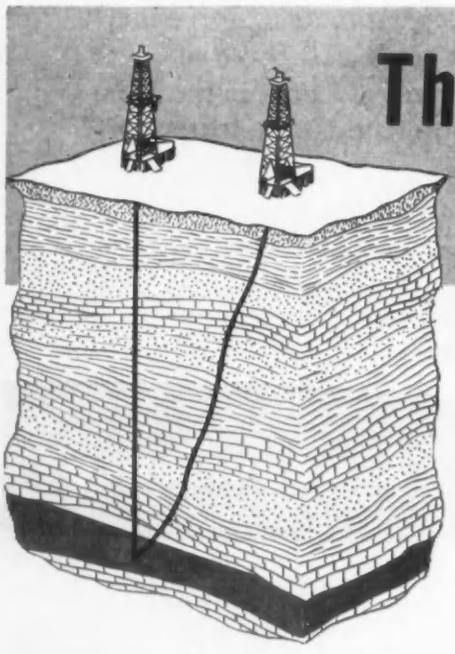
Lawrence County, Lawrence, West field. Moss & Wilson's H. Neal 1, NE SE NE 23-3n-13w, pumped 225 barrels from Bethel sand, Mississippian 2048-62 feet, completed 12-23-52, TD 2126.

Wabash County, Gards Point, North field. W. L. Griffith's Pixley Hrs. 1, NE NW SW 24-1n-14w, pumped 100 barrels from Lower O'Hara lime, Mississippian 2850-53 feet, completed 12-9-52, TD 2854.

White County, Sumpter, West field. D. B. Lesh's J. Shoeman 1, SE NW NE 27-4s-9e, pumped 14 barrels from Aux Vases sand, Mississippian 3166-70 feet, completed 12-16-52, TD 3172.

ILLINOIS—NEW OIL PAY

Richland County, Clay City Consolidated field. Pure Oil Co.'s Emma Walters 2,



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WICHITA FALLS
Hudson-Eads, Inc. - 2-3767, 2-8584, 3-4690

SE SW SW 5-3n-9e, Old Well Drilled Deeper, pumped 54 barrels oil and 96 barrels water from Warsaw lime, Mississippian 3598-3615 feet, completed 12-23-52, TD 3646.

ILLINOIS—OIL FIELD EXTENSIONS

Clinton County, Bartelso, West field. A. Schierman's H. Albers 1, NE NW NE 13-1n-4w, ¾-mile northwest extension, pumped 4 barrels from Cypress sand, Mississippian 984-86 feet, completed 12-23-52, TD 994.

White County, Concord field. Clark & Clark's F. Ackerman 1, NW NE SW 34-6s-10e, ½-mile extension, pumped 110 barrels from Aux Vases sand, Mississippian 2900-15 feet, completed 12-9-52, TD 2918.

INDIANA—NEW OIL FIELDS

Gibson County, East Patoka Area. Illinois Mid Continent Co.'s Clara Haper 1, NW NE NW 33-1s-10w, swabbed 15 barrels from O'Hara lime, Mississippian 1965-69 feet, TD 2039.

Pike County. Norm Appleby's John Carter 1, SW NE SE 26-1n-9w, pumped 10 barrels from Waltersburg sand, Pennsylvanian 933-40 feet, TD 978.

Unnamed field. Wm. Moser's Fred Richardson 1, SW NE SW 31-1s-7w, pumped 100 barrels from Cypress lime, Mississippian 1119-26 feet, TD 1126.

Vanderburgh County. Superior Oil Co.'s Glenard Kolb 1, SW NW 28-6s-11w, pumped 14 barrels oil and 8 barrels water from Jackson sand, Mississippian 2166-82 feet, TD 2632.

INDIANA—NEW OIL PAY

Gibson County, Lyles field. T. & H. Corp.'s Deep Vein Coal Co. 1, SE SE NE 11-2s-12w, swabbed 400 barrels from Salem lime, Mississippian 2675-80 and 2683-88 feet, TD 2710.

INDIANA—OIL FIELD EXTENSIONS

Gibson County, Princeton, North field. George & Wrather Oil Co.'s H. L. Cokes' Kinsbury Comm. 1, SE NW NE 31-1s-10w, ½-mile southwest extension, pumped 125 barrels from O'Hara lime, Mississippian 2020-26 feet, TD 2093.

Posey County, Welborn field. Ryan Oil Co.'s Carmen S. Flesher Community 2, SE SE NE 29-6s-14w, northwest extension, pumped 12 barrels oil and 5 barrels water from Cypress lime, Mississippian 2479-82 feet, TD 2785.

KANSAS—NEW OIL FIELDS

Barton County, Buckbee, Southwest field. Lewis Drilling Co.'s Buckbee 1, SW SW SE 15-20s-12w, potentialed 1551 barrels from Arbuckle lime, Ordovician 3373-85 feet, TD 3385.

Hiss, East field. Kiowa Drilling Co.'s Hiss 1, SW NW NW 33-20s-13w, pumped 50 barrels from Arbuckle lime, Ordovician 3550-66 feet, TD 3566.

Cowley County. Helmerich & Payne's Stucky A-1, NE NE NW 15-31s-4e, pumped 3 barrels from Bartlesville sand, Pennsylvanian 2930-38 feet, TD 2972.

Ellis County. Victor Drilling Co.'s Brungardt 1, SW NW SW 16-13s-20w, pumped 174 barrels from Arbuckle lime, Ordovician 3862-70 feet, TD 3870.

Finney County, Damme, South field. W. L. Hartman's Damme 10, SW SW SE 28-22s-33w, pumped 244 barrels from Mississippi lime, Mississippian 4767-76 feet, TD 4776.

Rooks County, Zurich, Southwest field. Mallonee Drilling Co.'s Aksamit 1, C S/2 SW SE 34-10s-19w, pumped 37 barrels from Lansing lime, Pennsylvanian 3385-94 feet, TD 3663.

Unnamed field. Heathman & Co.'s Jelinek 1, NW NE NE 30-19s-18w, pumped 149 barrels from Arbuckle lime, Ordovician 3610-16 feet, TD 3616.

Trego County, Ellis, South field. Todd Drilling Co.'s Newcomer 1, NE NE NE 12-13s-21w, pumped 152 barrels from Arbuckle lime, Ordovician 3816-37 feet, TD 3837.

KANSAS—NEW OIL PAY

Ellis County, Emmeram Townsite field. Victor Drilling Co. et al's Windholz 1, SW SW NE 6-13s-16w, pumped 600 barrels from Lansing lime, Pennsylvanian 3291-96 feet, TD 3570.

KANSAS—NEW GAS FIELD

Barber County. Skelly Oil Co.'s Lanker 1, C SE NW 1-33s-13w, flowed 6.4 million from Tonganoxie 3976-4003 feet, open, TD 4003.

KENTUCKY—NEW OIL FIELD

Henderson County. Slagter Producing Co.'s F. Palmer Critser 1, SE SE SE 11-Q-25, swabbed 170 barrels from Benoist (Bethel) sand, Mississippian 2000-10 feet, TD 2010.

KENTUCKY—NEW OIL PAY

Webster County. E. G. Burke, Sr.'s Jackson Heirs-L. J. Rogers-E. A. Debeauford 1, SE SE NW 25-M-23, pumped 32 barrels oil and 5 barrels water from Hardinsburg (Jones) sand, Mississippian 2686-2719 feet, TD 2719.

NORTH LOUISIANA—NEW GAS PAY

Desoto Parish, Logansport field. Southern Production Co., Inc.'s J. D. Williams Unit 2, in 29-12n-15w, flowed 6.8 million from Paluxy sand, Lower Cretaceous 2980-88 feet, open, completed 12-29-52, TD 3026.

SOUTH LOUISIANA—NEW OIL PAY

Jefferson Parish, Lafitte field. The Texas Co.'s Jefferson Parish School Board 4, in 16-17s-24e, flowed 42 barrels from 3931-35 feet, 11/64-inch, 26.4-gravity, completed 12-10-52, TD 5583.

SOUTH LOUISIANA—NEW DISTILLATE FIELD

Iberville Parish, Alabama Bayou area. The Texas Co.'s Iberville Land Co. 1, in 46-7s-8e, flowed 102 distillate and 4.7 million from 9410-16 feet, 20/64-inch, 56-gravity, completed 12-16-52, TD 11,100.

SOUTH LOUISIANA—NEW DISTILLATE PAY

West Baton Rouge Parish, Lobdell field. Humble Oil & Refining Co.'s M. J. Kahao, et al 1, in 82-7s-12e, flowed 129 distillate and 3.0 million from 8884-90 feet, ¼-inch, 53.9-gravity, completed 12-21-52, TD 9523.

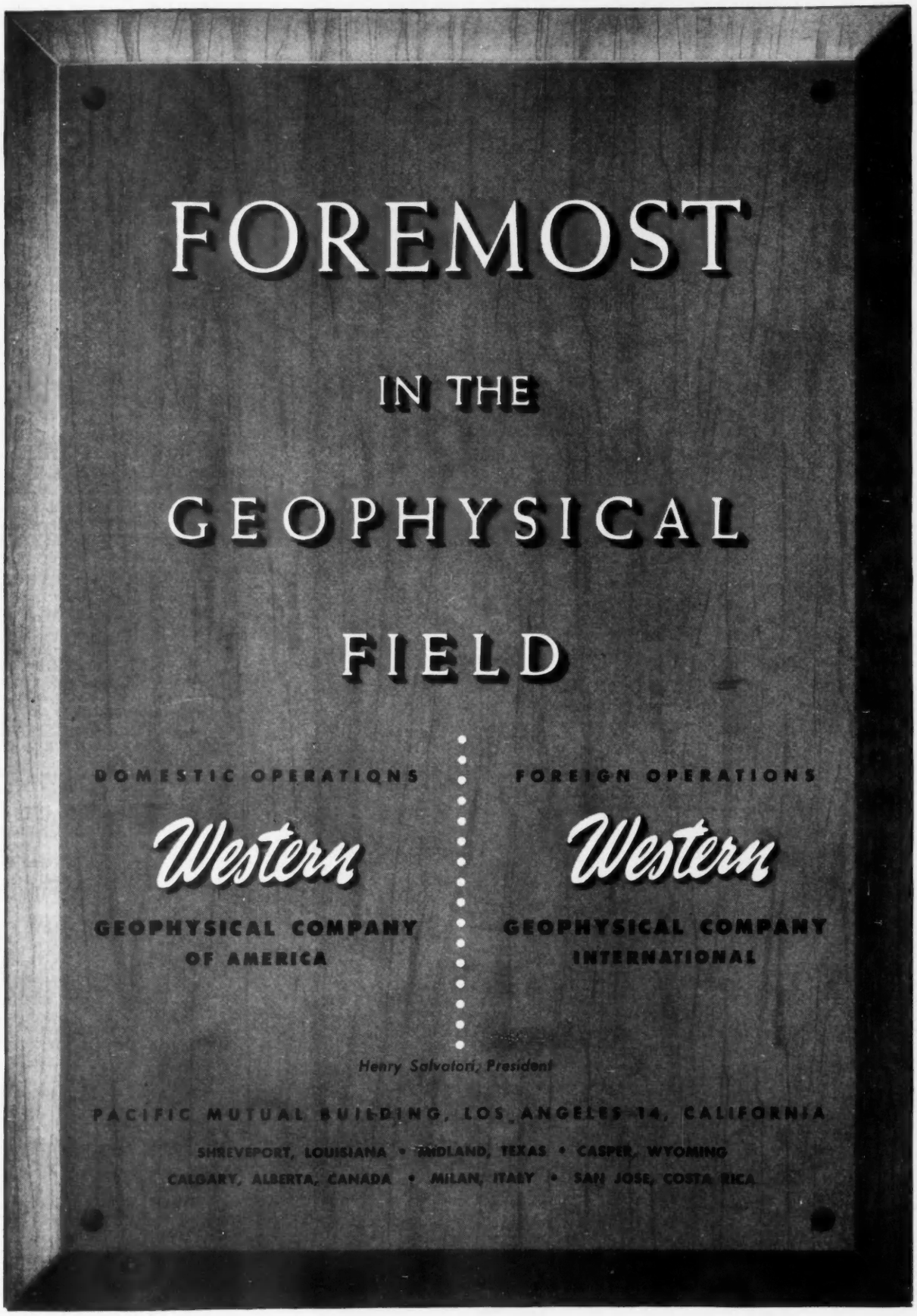
MICHIGAN—NEW OIL FIELD

Mason County. Dow-Brazos-Taggart Bros. Gas Co.'s Dow-Brazos Unit 1, SE NE NE 27-19n-18w, Hamlin Township, pumped 20 barrels oil and 20 barrels water from Niagaran lime, Silurian 4224-4326 feet, TD 6622.

MICHIGAN—OIL FIELD EXTENSIONS

Allegan County, Trowbridge "13" field. Louis Zellman's Thayer 1, NW NE SE 18-1n-12w, Otsego Township, east extension, pumped 7 barrels oil and 18 barrels water from Traverse lime, Devonian 1424-27 feet, TD 1427.

Muskegon County, Ravenna field. Clyde B. Miller's Hinsley School 1, SE SE NE 25-9n-15w, Sullivan Township, west exten-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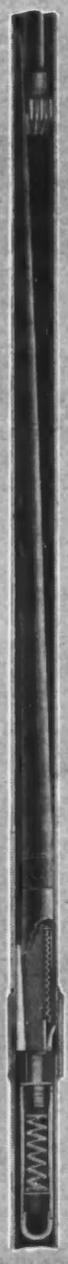

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sion, pumped 240 barrels from Traverse lime, Devonian 1834-37 feet, TD 1837.

Van Buren County, Lawton field. W. D. Gannett's Bale et al 1, SE SE NE 18-4s-13w, Porter Township, pumped 30 barrels from Traverse lime, Devonian 1113-16 feet, TD 1116.

MISSISSIPPI—NEW OIL FIELD

Adams County, Fairview, East field. Humble's N. H. Breaux D-1, in 10-4n-4w, flowed 266 barrels from Armstrong sand, Eocene 6710-20 feet, ¼-inch, 46.1-gravity, completed 12-10-52, TD 7300.

MISSISSIPPI—NEW OIL PAY

Lamar County, Baxterville field. Gulf Refining Co.'s J. M. Andrew 25, SE SW 6-1n-16w, flowed 160 barrels from Lower Cretaceous sand 10,821-841 feet, 12/64-inch, 40.9-gravity, completed 12-23-52, TD 13,431.

MONTANA—NEW GAS FIELD

Fallon County. Monoco Oil Corp.'s Baker 1, C NW SW SE 12-7n-60e, ungauged from 1829-2012 feet, completed 12-1-52, TD 2012.

NEBRASKA—NEW OIL FIELD

Cheyenne County, Geu field. Ohio Oil Co.'s H. J. Geu 1, SW NW NW 3-14n-48w, pumped 175 barrels from 3rd Dakota sand, Upper Cretaceous 4552-60 feet, completed 12-16-52, TD 4650.

NEBRASKA—GAS FIELD EXTENSIONS

Cheyenne County, Sidney, West field. Ohio Oil Co.'s G. Chambers 1, NW SE SE 14-13n-51w, 1½-mile southwest extension, flowed 3.5 million from "D" sand 4872-89 feet, completed 12-8-52, TD 5094.

Sidney, West field. Ohio Oil Co.'s Witters 1, NE NE SE 18-13n-50w, southwest extension, flowed 7.5 million from "D" sand, Upper Cretaceous 4840-60 feet, completed 12-4-52, TD 5049.

NEW MEXICO—NEW OIL FIELD

Lea County. Shell Oil Co.'s State CA-1, in 23-16s-36e, flowed 504 barrels from Wolfcamp lime, Permian 10,148-156 and 10,171-178 feet, 22/64-inch, 41-gravity, completed 12-12-52, TD 12,751.

NEW MEXICO—NEW GAS FIELDS

Lea County. Lone Star Production Co. et al's State King 1, in 16-9s-35e, flowed 2.5 million from San Andres lime, Permian 4740-4815 feet, completed 12-4-52, TD 10,015.

San Juan County. Stanolind Oil & Gas Co.'s Angel Peak Unit 2, NW SE SE 22-27n-10w, flowed 2 barrels and 0.6 million from Dakota sand, Upper Cretaceous 6530-6710 feet, completed 12-7-52, TD 6710.

OKLAHOMA—NEW OIL FIELDS

Coal County. Beach & Talbot & Sohio Petroleum Co.'s U. N. Guth 1, NW SE NW 22-2n-8e, flowed 220 barrels from Bromide sand, Ordovician 6908-7070 feet, 18/64-inch, 39.2-gravity, TD 7521.

Comanche County. Teakell Bros.' Horton 2, NE SW NW 21-2n-12w, pumped 2 barrels, 31-gravity from 85-102 feet, TD 102.

Creek County. Midwestern Constructors, Inc.'s J. E. Thrift 1, NW SE NW 9-18n-8e, flowed 60 barrels from Red Fork sand, Pennsylvanian 2750-52, 2756-66,

and 2770-73 feet, 14/64-inch, TD 2908.
Unnamed field. O. F. Warren's Mann 1, SW SE SW 14-18n-8e, flowed 4 barrels from Red Fork sand, Pennsylvanian 2702-18 feet, ½-inch, 38-gravity, TD 2874.

Garvin County. Davon Oil & Gas Co.'s Norvell 1, NE NE NE 10-3n-2e, pumped 25 barrels from Simpson sand, Ordovician 2761-64, and 2787-88 feet, 28-gravity, TD 2980.
Unnamed field. Davon's Thompson 1, SW SE NE 10-3n-1e, pumped 10 barrels from Hogshooter lime, Pennsylvanian 3208-18 feet, 25-gravity, TD 3367.

Kay County. Barron Kidd's Ida Wildgrube 1, NW NE SW 14-27n-1e, pumped 8 barrels from Lower Skinner sand, Pennsylvanian 3612-22 feet, TD 4161.

Okfuskee County. O. F. Warren's McIntosh-Palmer 1, SW NW NW 25-11n-10e, flowed 100 barrels from Gilcrease sand, Pennsylvanian 2930-46 and 2982-91 feet, ½-inch, 40-gravity, TD 4065.

Payne County. Atlantic Refining Co.'s Jaurch 2, SE SE NE 18-17n-4e, pumped 34 barrels oil and 22 barrels water from 1st Wilcox sand, Ordovician 4338-45 and 4350-57 feet, 39-gravity, TD 4393.

Seminole County. W. N. Foster's Dipple 1, SW SE SW 34-6n-6e, OLD WELL WORKED OVER, pumped 2 barrels from Senora sand, Pennsylvanian 1742-62 feet, TD 3564.

Washita County. Shell Oil Co.'s Adams Community 1, C SE SE 6-9n-19w, flowed 28 barrels from Des Moines sand Pennsylvanian 11,066-92 feet, and Granite Wash, Pennsylvanian 11,362-92 feet, 22/64-inch, 55.3-gravity, TD 12,500.

OKLAHOMA—NEW OIL PAY

Logan County, Evansville, Northwest field. Jordan Petroleum Co.'s Maude L. Dall 1, NE NE SE 35-16n-1w, pumped 25 barrels oil and 15 barrels water from 2nd Wilcox sand, Ordovician 5757-59 feet, 37-gravity, TD 5785.

OKLAHOMA—OIL FIELD EXTENSIONS

Logan County, Lucien field. Arthur Finston & Ben Novak's Archibald 1, NW NE SW 3-19n-2w, ½-mile extension, flowed 150 barrels from Lower Skinner sand, Pennsylvanian 4852-62 feet, ¼-inch, TD 5190.

Osage County, Kaw, South field. C. W. Oliphant's Osage 1, NE NW NE 6-25n-5e, east extension, flowed 191 barrels from Mississippi lime, Mississippian 3305-06 feet, TD 3306.
Little Chief, Northeast Feld. Sunray Oil Corp's Osage 1, NW NW SW 36-26n-6e, ¾-mile extension.

OKLAHOMA—NEW GAS FIELDS

Comanche County. Wm. H. Atkinson's Coody 1, NW NW NW 21-2n-9w, flowed 6 million from 758-60 feet, TD 3996.

Lincoln County. William Snakard's O. R. Ewingl, NW NW NE 12-13n-2e, flowed 2 million from Skinner sand, Pennsylvanian 4604-15 feet, TD 5348.

Stephens County. Amerada Petroleum Corp's Irene Riviere 1, NE NE SE 9-1s-5w, flowed 3.5 million from 5220-50 feet, open choke, TD. 6500.

OKLAHOMA—GAS FIELD EXTENSION

Cimarron County. Keyes, Southeast field. Big Chief Drilling Co.'s Wiggins 1, NE SW NE 33-4n-8ecm, flowed 4.6 million from Keys sand, 4807-17 feet, TD 4857.

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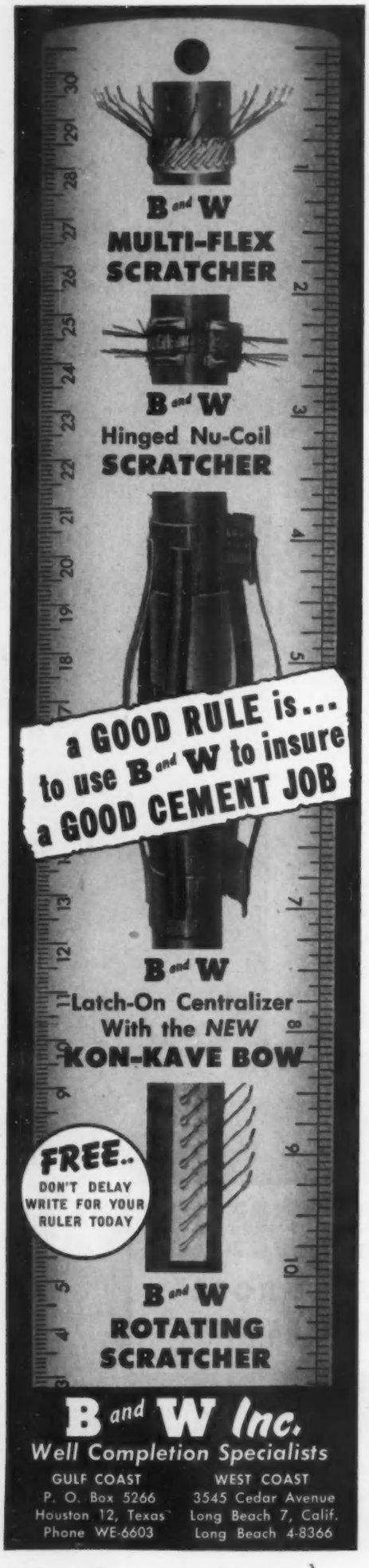

TEXAS DISTRICT 1—OIL FIELD EXTENSION

Frio County, Big Foot field. Gasoline Production Corp's Annie Lea Witting 1, Dan T. Price Survey, flowed 66 barrels from Navarro sand, Upper Cretaceous 3689-3730 feet, ⅛-inch, 41-gravity, TD 3730.

TEXAS DISTRICT 2—NEW OIL FIELD

Refugio County. Refugio-Fox field area. Fred W. Shield et al's Jamie Hynes 2, Isabella O'Brien Survey, flowed 25 barrels from Frio sand, Oligocene 4778-83 feet, 12/64-inch, 36-gravity, completed 12-8-52, TD 5297.

TEXAS DISTRICT 2—DISTILLATE FIELD EXTENSION

Lavaca County. Provident City field. Salt Dome Production Co.'s Unit 4 Hancock-Commerce Tr. Co. et al 1, F. C. Pitzer Survey, Block 74, Section 6, ¾-mile extension, flowed 17 barrels distillate and 9 million from Wilcox sand, Eocene, open choke, completed 12-1-52, TD 9883.

TEXAS DISTRICT 2—NEW DISTILLATE FIELD

Goliad County. David L. Gordon's Gussie W. Pettus 1, Maria de Jesus Y'Barbo Grant, flowed 85 barrels distillate and 9.4 million from Mackhank sand, Eocene 8288-93 feet, completed 12-15-52, TD 8450.

TEXAS DISTRICT 2—NEW GAS FIELD

Calhoun County, Princess Lake area. Humble's Espiritu Santo Bay State Tract 201-1, Espiritu Santo Bay Survey, ungauged from 6163-68 feet, completed 10-10-52, TD 6501.

TEXAS DISTRIST 2—NEW GAS PAY

Goliad County, Maetze field. W. C. McBride, Inc.'s O. G. Dreier 1, J. T. Kilgore Survey, flowed 45 million from Frio sand, Oligocene 3126-30 feet, open choke, completed 12-26-52, TD 4060.

TEXAS DISTRICT 3—NEW OIL FIELD

Wharton County. Salt Dome Production Co.'s H. Mollnar 1, E. C. Ogden Survey, Section 30, flowed 130 barrels from Lower Frio sand, Oligocene 6166-69 feet, ⅛-inch, 39.3-gravity, completed 12-4-52, TD 6315.

TEXAS DISTRICT 3—NEW OIL PAYS

Brazoria County, Manvel Dome, East Flank field. William S. Thompson's Helen J. Way 2, HT&B Survey, Section 33, flowed 392 barrels from Miocene sand 4035-58 feet, ¼-inch, 26-gravity, completed 12-4-52, TD 4058.

Harris County, Finfrock field. The Texas Co.'s H. D. Taylor 4, H. D. Taylor Survey 7, ½-mile northeast of production, flowed 48 barrels from Watson sand, Eocene 6875-78 feet, 20/64-inch, 41-gravity, completed 12-20-52, TD 8000.

Jefferson County, Big Hill field. Hudson Gas & Oil Corp's M. B. Finkelstein 1, T. J. Baldwin Survey, Section 374, Block 624, flowed 307 barrels from Marginulina sand, Oligocene 9256-60 and 9267-71 feet, 10/64-inch, 35.6-gravity, completed 12-5-52, TD 9292.

Liberty County, Quinn field. Sohio Petroleum Co.'s B. E. Quinn, Jr. 3, James Humphreys Survey, flowed 52 barrels from Yegua sand, Eocene 6205-07 feet, 8/64-inch, 39-gravity, completed 10-20-52, TD 7480.

TEXAS DISTRICT 3—OIL FIELD EXTENSION

Wharton County, Magnet Withers, East field. Humble's H. C. Cockburn 56, Joseph Clements Survey, Block 63, ½-mile southeast extension, flowed 12 barrels from Frio sand, Oligocene 5916-42 feet, 5/64-inch, 30.3-gravity, completed 11-1-52, TD 7000.

TEXAS DISTRICT 3—NEW DISTILLATE PAY

Galveston County, Gillock field. Pan American Production Co.'s D. J. Monen 1, John W. Lytle Survey, flowed 74 barrels distillate and 5.3 million from Lower Frio sand, Oligocene 11,664-678 feet, open choke, 55-gravity, completed 12-7-52, TD 12,502.

TEXAS DISTRICT 3—DISTILLATE FIELD EXTENSIONS

Liberty County, Dayton, North field. Corley & Geiselman's Kline Gas Unit 1, H&TC Survey, Section 125, ¾-mile southwest extension, flowed 365 barrels distillate and 8.1 million from Yegua sand, Eocene 8034-50 feet, open choke, 64-gravity, completed 11-25-52, TD 8217.

San Jacinto County, Urbana field. Stanolind Oil & Gas Co.'s Emily Langham B-1, T. Simpson Survey, 1-mile east extension, flowed 110 barrels distillate and 2.3 million from 10,085-110 feet, ½-inch, 55.2-gravity, completed 12-16-52, TD 12,502.

Wharton County, West Bernard field. John W. Mecom et al's W. C. Leveridge et al 1, John F. Stevenson Survey, ½-mile east extension, flowed 287 barrels distillate and 14 million from Clodine sand, Eocene 7198-7214 feet, open choke, 56.8-gravity, completed 12-11-52, TD 7650.

TEXAS DISTRICT 3—NEW GAS FIELDS

Matagorda County. J. S. Michael's Hamill et al 1, Wm. Baxter League, ungauged from 3249-58 feet, completed 11-10-52, TD 6787.

Wharton County. G. S. Hinkle & C. B. Webster et al's Mentor Northington 1, J. W. Jones League, flowed 75 million from Miocene sand, 4352-59 feet, open choke, completed 11-28-52, TD 7500.

TEXAS DISTRICT 3—GAS FIELD EXTENSION

Jefferson County, Big Hill field. Adams & Haggarty's Marrs McLean 1, EL&RR Survey, ½-mile southwest extension, ungauged from TD 8207, completed 12-20-52.

TEXAS DISTRICT 4—NEW OIL PAYS

Kleberg County, Bird Island field. Panhandle Oil Corp.'s State of Texas Tract 156-1, Laguna Madre, flowed 168 barrels from Frio sand, Oligocene 7235-39 feet, 10/64-inch, 42-gravity, completed 11-16-52, TD 7277.

San Patricio County, Ewing field. Southern Minerals Corp.'s R. Sharp Gerdes 2, G. H. Paul Subdivision, Section 12, flowed 102 barrels from 7001-07 feet, ⅛-inch, 29.6-gravity, completed 12-25-52, TD 7008.

Starr County, Kelsey, South field. Humble's McGill Bros. A/C 2-174, La Blanca Grant, flowed 154 barrels from Vicksburg sand, Oligocene 7326-38 feet, 38.5-gravity, completed 12-30-52, TD 8582.

Starr County. Taylor Oil & Gas Co.'s Manuel Yzaguirre Est. 4, Block 227, flowed 85 barrels from Vicksburg sand,

Oligocene 8042-48 feet, 9/64-inch, completed 12-29-52, TD 9008.

Zapata County, West Jennings field. South Texas Oil & Gas Co.'s Toribio Garza 1, San Antonio de Mira Flores Survey, pumped 47 barrels from Crockett sand, Eocene 3039-46 feet, 33-gravity, completed 12-12-52, TD 3058.

TEXAS DISTRICT 4—NEW DISTILLATE FIELDS

Kenedy County. Sun Oil Co.'s Dunn-McCampbell 2, J. S. Boyles Survey, Padre Island, flowed 96 barrels distillate and 24 million from Marginulina sand, Oligocene 7250-80 feet, open choke, 49.7-gravity, completed 12-17-52, TD 7633.

Nueces County. Humble's Ninna G. Stewart 1, Mariano Lopez de Herrara Grant, McIntyre Partition, flowed 24 barrels distillate and 1.6 million from Frio sand, Oligocene 5282-97 feet, 1-inch, 53.4-gravity, completed 12-13-52, TD 7996.

San Patricio County, Riverside area. Lockhart Oil Co. of Texas' J. R. Marmion 1, Day Land & Cattle Co. Survey, flowed 79 barrels distillate and 2.5 million from Marmion sand, Oligocene 6307-15 feet, 71.9-gravity, completed 12-16-52, TD 6500.

TEXAS DISTRICT 4—NEW DISTILLATE PAY

Hidalgo County, South Weslaco field. La Gloria Corp.'s South Weslaco Gas Unit 10, West Ract Subdivision, Block 165, flowed 13 barrels distillate and 1.3 million from 9452-87 feet, open choke, 51-gravity, completed 12-4-52, TD 15,022.

TEXAS DISTRICT 4—DISTILLATE FIELD EXTENSION

Starr County, El Ebanito field. The Chicago Corp.'s State-Slick B-1, Survey 886, south extension, flowed 11 barrels distillate and 3.1 million from "H" sand, Oligocene 4682-86 feet, ⅛-inch, 61-gravity, completed 12-3-52, TD 4727.

TEXAS DISTRICT 4—NEW GAS FIELDS

Aransas County, Blind Pass area. Richardson & Bass' Unit #5 State of Texas Lease 31907-1, Aransas Bay, State Tract 262, ungauged from 8064-72 feet, completed 11-12-52, TD 10,923.

Duval County. Panhandle Oil Corp.'s Driscoll Est. A-1, Section 213, Block 14, ungauged from Cole sand, Eocene 2538-41 feet, completed 12-29-52, TD 2690.

Jim Hogg County. Sinclair Oil & Gas Co.'s Aurora G. Gallagher 3, Rafael de la Pena Survey, flowed 7.8 million from Loma Novia sand, Eocene 3616-21 feet, and 1.4 million from Gallagher sand, Eocene 3719-23 feet, completed 12-16-52, TD 4495.

San Patricio County, Midway Downdip area. Humble's T. A. McKamey 1, San Patricio School Lands 4 Survey, ungauged from Basal Frio sand, Oligocene 9945-65 feet, completed 10-15-52, TD 10,500.

TEXAS DISTRICT 4—NEW GAS PAYS

Duval County. Appell Drilling Co. & George W. Lyle's W. R. Peters Est. 1, Survey 398, ungauged from Argo sand, Eocene 2292-98 feet, completed 12-8-52, TD 2740.

Kleberg County, Ritchie field. Ritchie & Mumme Oil Co.'s K. J. Kivlin et al 3, Kleberg County Improvement & De-

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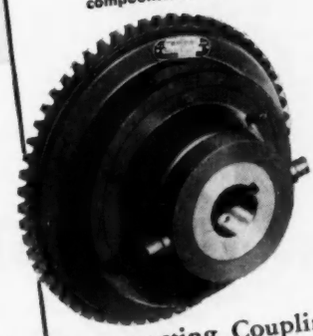

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velopment Co. Survey, Section 39, Block 7, ungauged from TD 3400, completed 11-21-52.

TEXAS DISTRICT 6—NEW OIL FIELD

Cherokee County. W. M. Kay et al's Noble Kee 1, in R. H. Tobin Survey, flowed 64 barrels from Woodbine sand, Upper Cretaceous 3768-70 feet, 5/64-inch, 39-gravity, completed 12-5-52, TD 3770.

TEXAS DISTRICT 7-C—NEW OIL FIELD

Runnels County. H. D. Dew & Ray Culbertson's W. M. Culp 1, A. J. Loverly Survey 311, flowed 168 barrels from Morris sand, Pennsylvanian 4251-56 feet, 16/64-inch, 41-gravity, completed 12-22-52, TD 4256.

TEXAS DISTRICT 7-C—OIL FIELD EXTENSION

Coke County, Bronte, North field. Lion Oil Co's Mary Rawlings 1, Section 390, Block 1-A, H&TC Survey, ¾-mile north extension, flowed 868 barrels from Gardner sand, Pennsylvanian 5310-25 and 5334-42 feet, 16/64-inch, 50.6-gravity, completed 12-22-52, TD 5677.

TEXAS DISTRICT 8—NEW OIL FIELDS

Andrews County. Phillips Petroleum Co.'s Texas University "JJ" 1, Section 18, Block 10, University Lands Survey, pumped 108 barrels from San Andres lime, Permian 4620-80 feet, 31.2-gravity, completed 12-5-52, TD 12,340.

Dawson County. Cities Production Co.'s J. B. Leverett B-1, Section 3, Block 4, D. L. Cunningham Survey, flowed 154 barrels from Spraberry sand, Permian 7690-7726 feet, 38.5-gravity, completed 12-9-52, TD 11,900.

Kent County, Salt Creek area. General American Oil Co. of Texas' Atkins Unit 1, Section 114, Block G, W&NW Survey, pumped 115 barrels from Canyon Reef lime, Pennsylvanian 6622-37 feet, 40.1-gravity, completed 12-15-52, TD 6659.

TEXAS DISTRICT 8—NEW OIL PAY

Gaines County, Jenkins, North. Humble's James B. Riley et al 1, Section 363, Block G, CCSD&RGNG Survey, flowed 611 barrels from Canyon lime, Pennsylvanian 8990-9010 feet, 22/64-inch, 41.8-gravity, completed 11-30-52, TD 10,000.

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TEXAS DISTRICT 8—OIL FIELD EXTENSION

Hockley County, Ropes field. Honolulu Oil Corp. & Signal Oil & Gas Co.'s T. H. Matthews 1, Tract 11, League 13, Howard CSL Survey, 2-mile southwest extension, flowed 1673 barrels from Canyon Reef lime, Pennsylvanian 9280-86 feet, 1-inch, 42-gravity, completed 12-20-52, TD 9370.

TEXAS DISTRICT 8—NEW GAS FIELD

Culberson County. Grisham-Hunter Corp. & M. A. Grisham's M. A. Grisham Fee 1-10, Section 10, Block 60, T-5, T&P Survey, flowed 9.9 million from Devonian lime, Devonian 9030-54 feet, open choke, completed 9-8-52, TD 9054.

UTAH—NEW OIL FIELD

Uintah County, Gusher area. The California Co.'s Unit 3, E½ NW NE 10-6s-20e, pumped 31 barrels from Basal Green River lime, Eocene 7932-55 and 7967-87 feet, completed 12-1-52, TD 8633.

UTAH—OIL FIELD EXTENSION

Uintah County, Red Wash field. The Carter Oil Co.'s Orlan L. Johnson 1, SW SW 8-7s-24e, 1½-mile northeast extension, pumped 189 barrels from Basal Green River lime, Eocene 5520-5626 feet, 30.9-gravity, completed 12-4-52, TD 5716.

WYOMING—NEW OIL FIELD

Sweetwater County, Middle Mountain area. Stanolind Oil and Gas Co.'s Unit 1, S½ NE NE 10-12n-103w, flowed 169 barrels from Mesa Verde sand, Upper Cretaceous 6534-48 feet, 54-gravity, completed 11-28-52, TD 8506.

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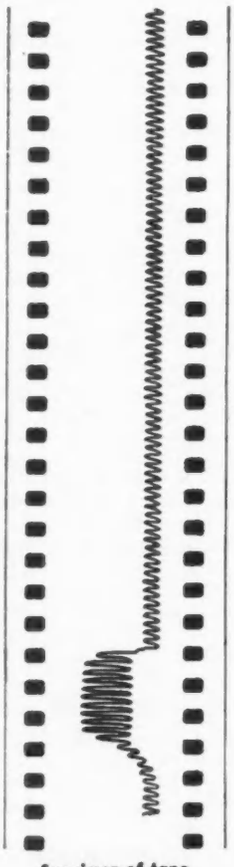

Specimen of tape indicating saturation

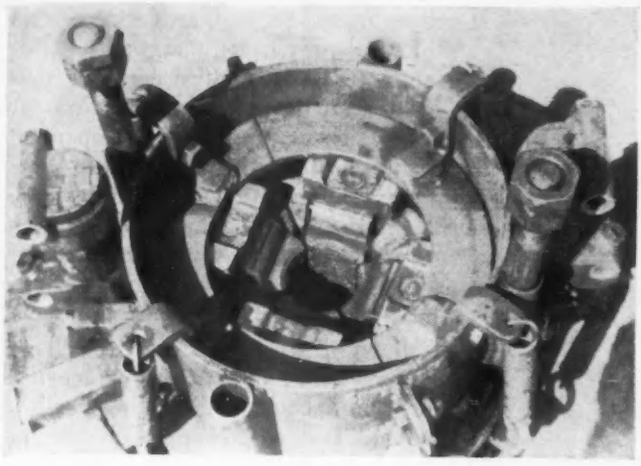

FIGURE 1.
Hydraulically-operated inverted slips snub pipe in and out of the well.

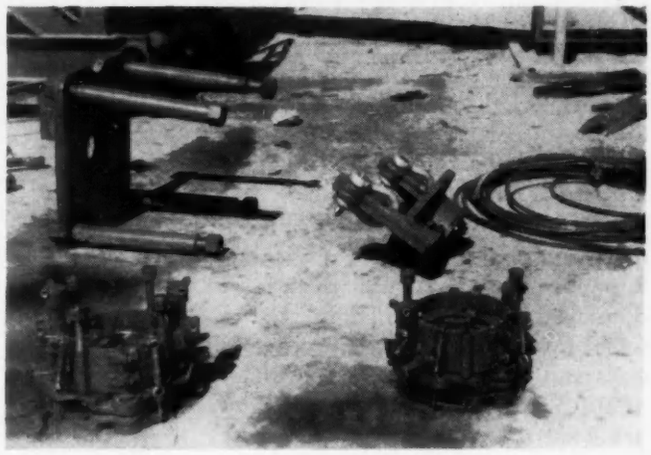

FIGURE 2.
Snubbing line and major components of traveling and stationary snubbers.

Running and Pulling Pipe Under Pressure

- **Conserves productive sands.**
- **Saves money on workovers.**
- **How it's done and where it will do the most good.**

By W. L. (LUKE) LONG, Executive Vice President
Pressure Services, Inc., Dallas

ALTHOUGH IT HAS many applications in the field, the special technique of running and pulling pipe under pressure and its many and varied applications are not generally understood by oil operators or field personnel. This article is presented to discuss the technique involved and to point out some of the many useful applications being made today by operators of both producing and drilling wells.

Some operators believe the technique is useful only in the case of well blow-outs connected with drilling operations. It is true that much pipe has been run in drilling wells where excessive pressures unloaded the drilling fluid, etc. However, by and large the most extensive application is to conserve productive sands and to effect economical work-overs. There are many other uses which will be briefly listed here.

Operators in many areas have learned that killing a well by using weighted fluids causes irreparable damage to certain formations. Such wells are slow to come back and some may never attain the level of productivity prior to a workover. In such instances running and pulling pipe with the well still flowing, or shut-in, eliminates the possibility of damaging the pay zone.

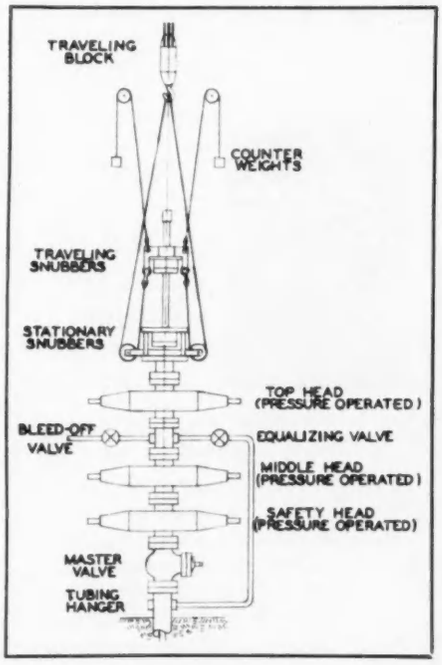

FIGURE 3.
Schematic drawing of control equipment.

In many cases it is more economical to work over the well under pressure than to kill it. Some of the considerations include difficulties in obtaining sufficient water in arid regions, excessive mud loss in the formation, additional expense in providing pits and mixing machinery, as well as the cost of expensive chemicals for weighing mud which may not only be lost into the formation, but may even plug the pore spaces and reduce oil recovery.

Snubbing pipe under pressure is also effective in partial workover operations. Examples of this type of work are resetting the weight on packers, changing tubing hangar mandrels or replacing leaking seals in the hangar mandrels, tubing wells that have been producing through the casing only and replacing damaged joints or collars.

The technique has proved effective in certain drilling operations and unusual well repair work. It is known that some formations will not break down at pressures less than the safe working pressure of the casing. Such wells are impossible to kill from the surface if the drill pipe or tubing is out of the hole.

Excessively high pressures may render it inadvisable to shut in a well and pipe must be run to bottom under pressure with the well flowing into tanks to keep the pressure down to a safe level so that the well can be killed. Relatively high sand bridges in tubing or casing or drill pipe which may trap the well pressure below and

make it impossible to load the hole safely in the remaining column above the bridge, can be drilled out under pressure. As the bridge is penetrated the pressure is retained by the preventors and the pipe and bit can be snubbed in or out of the well.

Another application of this technique is to make outside or inside cuts to remove sections of pipe which have developed holes, restrictions, or to wash over stuck pipe. Impressions, mills and overshot may be run under pressure to mill or pick up pipe that has been dropped, cut, or otherwise parted too close to the surface to allow the well to be killed.

Pipe which has become plugged by swabs, foreign steel or other matter which prevent pumping fluid into the well has been removed under pressure and rerun to complete the repair. In instances where pressure must be maintained above a packer or retainer in order to pull it, or where a packer or retainer swabs the hole as it is being removed, this method is used. It can be used to install pressure control equipment on drilling wells when abnormally high pressures are anticipated, as a safety measure.

Some of the questions more frequently asked when the technique is under discussion are:

- How can you get the pipe in and out of the hole under pressure and still keep it in control?
- Do you work only on wells that are in trouble? (This question has already been answered as some of the applications of the technique have been shown.)
- Isn't the operation fairly expensive?

For a clear understanding of the mechanics of running and pulling pipe under pressure consider a job on a 10,000-foot well equipped with two-inch tubing, production packer, tail pipe and a perforated sub below the packer. For example, say the well is producing under 2000 pounds-per-square-inch pressure. A leaky packer is suspected and the operator decides to inspect and replace if necessary, but without killing the well.

This is where the pressure service technique is called into play. First a workover unit is moved onto the location. This may be a workover rig or a pulling unit. The tubing is then plugged with a removable tubing plug

After weight of pipe overcomes pressure force acting on it, snubbers are removed. Pipe is run then as in any regular operation, except collars are lubricated through control equipment.

run on a measuring line and the tubing string bled to atmosphere. By installing this plug in the joint above the perforations, any leak in the tubing string will be evidenced by failure of the tubing pressure to bleed off and can be located in a matter of hours with the wire line unit. As soon as the tubing is bled to zero the tree is removed down to the doughnut. Then, building upwards from the tubing hangar flange, a master valve, two blowout preventors, a tapped spool or cross tee, and a third blowout preventor are installed. (See Figure 3). The blowout preventors are operated hydraulically and manifolded to three hydraulic operating valves supplied by a pressure pump some distance from the well with a variable regulator at the manifold to permit instant pressure changes on the operating circuit.

Two high pressure valves are mounted on the spool or cross tee, one being connected to the casing to allow equalization of pressures between the top and middle preventors, the other permitting the same area to be bled to atmosphere through a line laid away from the well.

A pickup sub is then screwed to the doughnut and the top preventor is closed around this sub. The pressure is equalized below the top preventor by opening the equalizing line and the doughnut is picked up out of the hangar to a point just below the top preventor. The middle preventor is closed around the pipe below the doughnut, the area between the top and middle preventor bled to atmosphere, the top preventor opened and the doughnut picked up, slips set and the pickup sub and doughnut broken out of the string. Similarly each collar is passed and the tubing is pulled with no free blow of the well pressure at any time.

Snubbing equipment is installed in advance of the point at which the force of the well pressure acting on the cross sectional area of the tubing becomes greater than the weight of the tubing remaining in the well. (In this hypothetical operation it would be 2000 psi times an area of 4.43 square inches equal 8860 pounds force.) This snubbing equipment consists of two sets of inverted slip type grips (See Figure 1) with the slips hydraulically operated and spring loaded in the closed position to preclude any possibility of turning the pipe loose in the event of hydraulic failure.

One set of the snubbers is flanged to the well control equipment and is stationary while the other set is free to travel up and down along the pipe. This traveling set has its weight overbalanced by weights suspended from the derrick or mast and their upward or downward travel is controlled by the unit blocks. A wire rope is con-

■ CONTINUED ON PAGE 116

About the Author

W. L. (LUKE) LONG, executive vice president in charge of field operations for Pressure Services, Inc., at Dallas is a veteran of 17 years of oil field experience, 16 actively engaged in pressure control work. He has seen service on many difficult wells throughout the U. S. and foreign countries and is recognized authority on pressure problems.

Electrical Conduction In Fluid-Saturated Rocks

PART 1

This valuable tool often is discussed in complicated and technical terms. Here's a plain-language review of the topic.

By DR. B. F. HOWELL, JR.
Chief of Division of Geophysics and Geochemistry
The Pennsylvania State College, State College, Penn.

IN ELECTRICAL resistivity logging, the property of the rock which one tries to measure is its resistivity. This is found by measuring currents and voltages on a system of electrodes, some or all of which are lowered into the well. Resistivity is found by taking the ratio of voltage to current as measured by the logging apparatus, multiplying by a calibration factor which depends on the particular electrode arrangement used, and often making corrections for such supposedly known conditions as bed thickness and bore water salinity. Although many uncertainties and approximations are involved in this process, for the purposes of the discussion which follows it will be assumed that the true resistivity of a rock can be found. Inaccuracies in its determination will tend to limit the preciseness of information which can be obtained from it.

The petroleum engineer or geologist who uses the logs is not interested in the resistivity for its own sake, but in other rock properties whose variations he can relate to observed variations in resistivity. To understand why such correlations exist, and to what degree resistivity can be used to determine such things as porosity, permeability and saturation, one must understand clearly what resistivity is, and how it is controlled by the nature of the rock.

Far too many petroleum geologists and engineers who use electric logs have only the vaguest notions as to what it is they are measuring. If electric logs are to yield dependable and quantitative information about reservoir rocks the men who do the interpretations must be thoroughly aware of all the factors which control the electrical behavior of rock, and not depend any more than absolutely necessary on empirical formulas and general rules which often apply only for a limited range of conditions. What follows is an attempt to explain in simple language the present state of knowledge of what determines the resistivity of a fluid saturated rock.

Nature of Electrical Conduction

Resistivity is defined as "the ratio of the electrical field within a conductor to the rate of flow of charge per unit area in the direction of the field" (Harnwell, 1938):

$$\rho = \frac{F_e}{I/A} = \frac{E/\Delta}{Q_e/tA} \qquad (1)$$

where ρ = resistivity in the direction of the electrical field
F_e = force drawing the electric current along (Voltage drop, E, divided by distance over which it is measured, Δ)
I = electric current flowing across area A
Q_e = charge flowing across Area A in time t

To understand what we mean by resistivity, we must understand what an electric current is. Within a uniform solid medium the current may consist of a flow of electrons. We can think of the electrons as being dragged through a mesh of atom nuclei, and ρ as the frictional drag of fixed framework on the moving electrons (Figure 1). As we reduce the size of the volume we are considering, the picture remains satisfactory until the dimensions of the volume become comparable in size to the distance between atoms.

In the case of an electrolytic solution the situation is similar, only instead of small, light electrons being moved, large, heavy ions (charged atoms) have to be dragged through the fluid water. In some cases the charged bodies may even consist of colloidal particles (micelles).

In either case, the resistivity depends on the relation of the electrical field E/Δ to the amount of charge, Q_e, which is present. For the same field strength, the resistivity decreases as the charge increases. In solids the charge consists of electrons which are provided by the atoms of which the solid is composed. Metals are good conductors because there are loosely attached electrons in each atom which can be easily drawn off by the electric

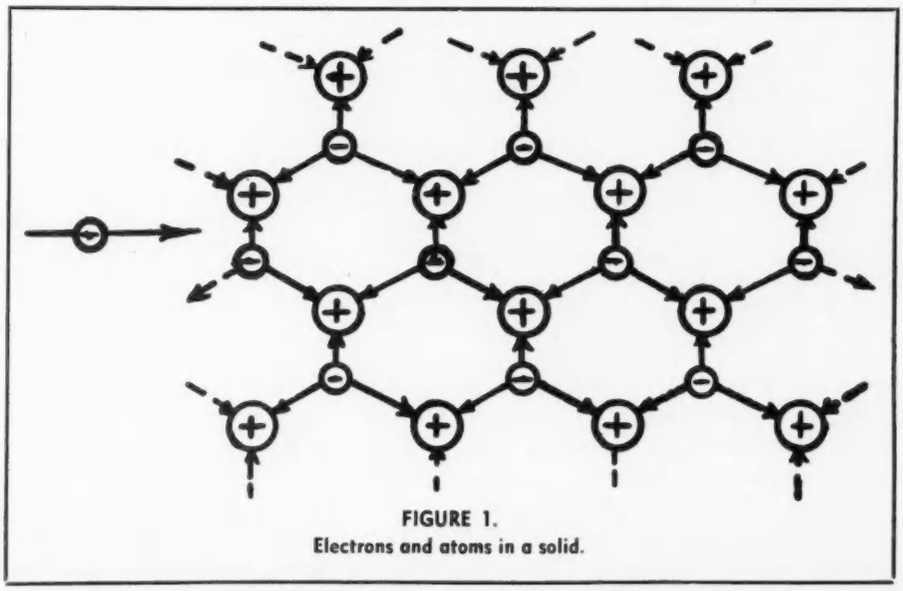

FIGURE 1.
Electrons and atoms in a solid.

field. Most naturally occurring minerals, on the other hand, are poor conductors because there are few electrons which are not tightly bound to some atom; and hence Q_e is small for such materials.

Electrolytic solutions conduct because the dissolved salt dissociates into its component ions. One member of each group carries with it one or more of its partner's electrons, so that all are charged, some negatively and others, which lost electrons, positively. It is the water which causes this dissociation. Not all fluids do so, and no other so strongly as water. In the case of petroleum there are almost no charged atoms or free electrons present; and, therefore, these materials are almost unable to conduct electricity. Most gases are similarly poor conductors. Thus we have three simple situations, metallic conduction by electrons, electrolytic conduction by ions (or by micelles, in which case the phenomenon is called electrophoresis) and non-conduction (insulation) in the absence of free electrons or other charged particles.

This is an ideal picture. Few media are so simple as those described above. Consider a single crystal of metal where the atoms have a regular arrangement (Figure 1). It will be easier to draw the free electron through the lattice parallel to the layers than at some odd angle where it frequently bumps into the positive nuclei and negative fixed electrons. Furthermore, around the edges of the crystal there are unsatisfied bonds which will attract or repel the electron depending on whether the unsatisfied bond is connected to a nucleus or an electron. In a large aggregate of crystals randomly oriented the effects of the many boundaries can be averaged out, and resistivity can be visualized as before. However, it should be realized that this average resistivity may be different from that in any particular direction through any one particle, as the electron moves with a very irregular velocity, especially near the boundaries of the crystals.

Conduction by a Rock

In a solid such as a rock, the situation is even more complicated. All three kinds of medium are present with a variety of complex interrelations. Parts of the framework consist of solid, crystalline material of the non-conducting variety. Quartz is such a mineral. Other minerals such as magnetite have appreciable ability to conduct. However, minerals of this last sort constitute only a very small percentage of most rocks. The pores

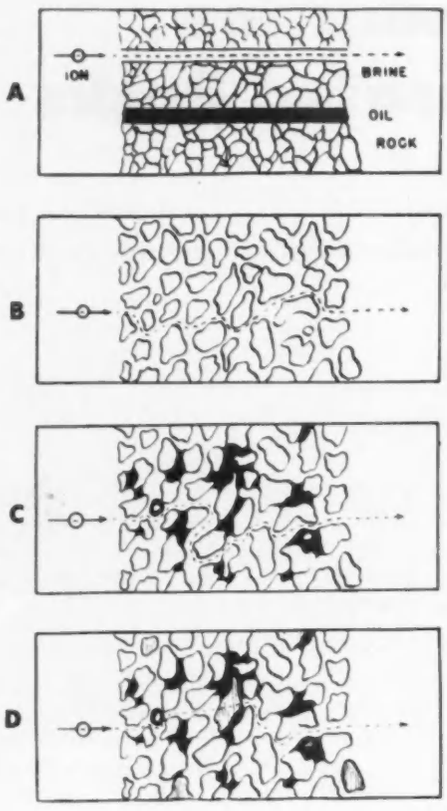

FIGURE 2.
Electrical conduction by a porous rock. A—Pores present as straight tubes. B—Water saturated. C—Partly oil saturated. D—Some minerals conducting.

in this framework are filled with electrolytic and non-conducting fluid. Furthermore, the framework and the electrolyte are not independent, unconnected materials, but react on one another in a complicated manner. The unsatisfied bonds on the surfaces of the solid grains, in particular, influence the concentration and nature of the charged particles in the adjoining electrolyte. Thus a clay particle in contact with water may give up, exchange or withdraw ions from the solution (Keller 1951, Pirson 1950). This changes the latter's ability to conduct. Or the clay may deflocculate providing charged colloidal particles. Ions and micelles provided in this manner may have only limited freedom to move, and it may be impossible to wash them from the rock by flooding. Hence they do not contribute to what we normally think of as the salinity of the water. Since clay minerals are often present as films coating the surfaces of the pores, as well as in bulk (large grains), conduction may in certain cases depend greatly on the amount of clay present in the rock, even though dry clay is a poor conductor. For convenience in the discussion which follows any conduction due to such deflocculation, ion release or ion interchange will be called "clay conduction" regardless of whether it is due to clay or some other mineral behaving similarly.

One can think of this complex medium as having an average resistivity only by viewing it in large masses, and not letting the dimensions of the volume under consideration become comparable in size to the diameters of the pores or mineral grains. However, it is the relationships between these various elements, framework, solution and insulating fluid, that one wishes to determine from electrical studies. To understand these dependencies, it must be known in detail how each part contributes to the average resistivity being measured.

With this aim in view, consider how a charge progresses through a rock (Figure 2A). Let us first suppose that the rock consists only of non-conducting particles with the pores filled with a solution of uniform conductivity ρ_e. If the water were present in the rock in straight tubes, parallel to the direction of current flow, and occupying a fraction, Φ_w, of the volume of the rock, and if the water carried all the current flowing with the adjoining rock having no influence on the conduction, then the following equation would apply:

$$\rho_{n1} = \frac{\rho_e}{\Phi_w} \qquad (2)$$

where ρ_{n1} = resistivity of a bank of tubes of water and ρ_e = resistivity of the water.

If the rock contained also some similar pores filled with oil and gas, then:

$$\Phi_w = S_w \Phi \qquad (3)$$

where Φ is the total porosity of the rock, and S_w is the fraction of these pores filled with water.

In the actual rock, the pores are not present as straight tubes, but have an effectively greater length due to their sinuous, interconnecting paths, variations in cross sectional area and shape, and the lack of continuity of some openings (Figure 2B). The resistivity of the network, ρ_{n2} would be greater than ρ_{n1} by a tortuosity factor, T, which takes this into account:

$$\rho_{n2} = \frac{T\rho_e}{S_w \Phi} \qquad (4)$$

T is composed of two parts. First, if the rock is completely saturated with water then T is a purely geometric property of the rock framework, related only to the shapes and distribution of the pores. It is not necessarily related to their size or to

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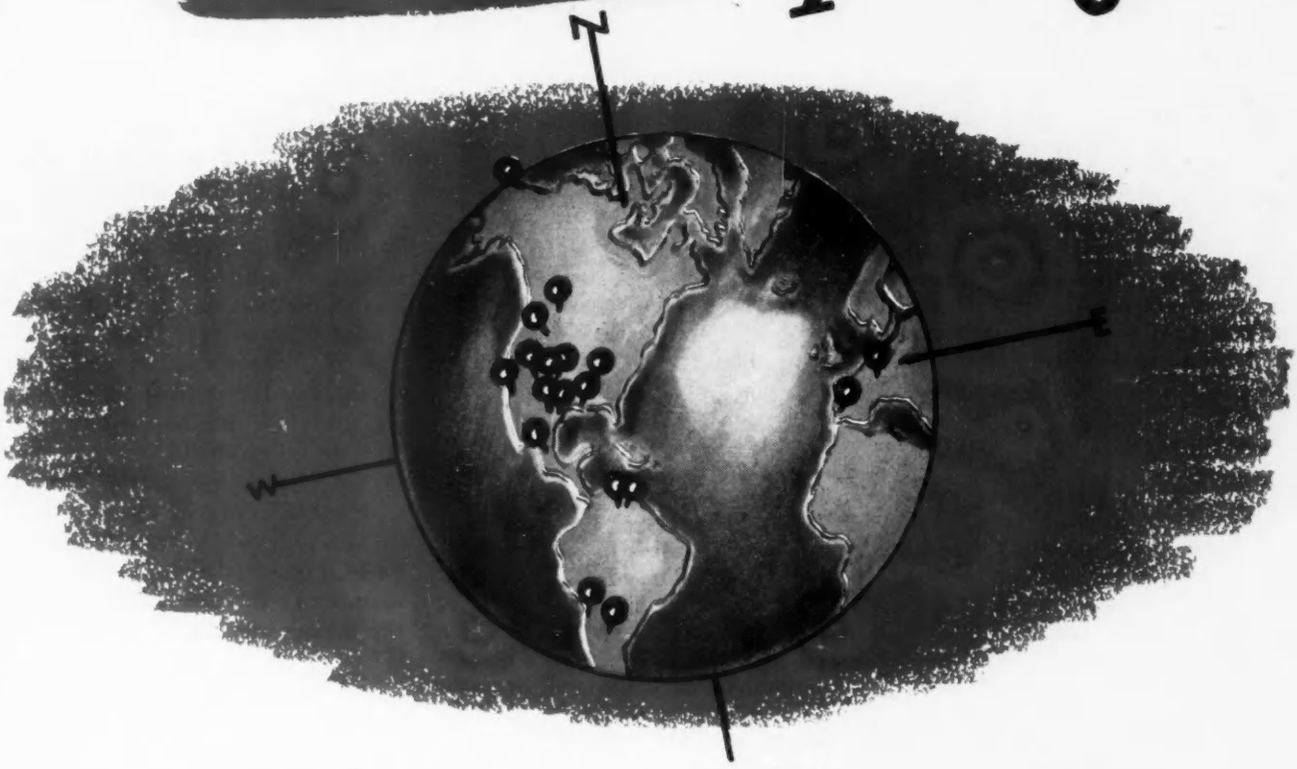

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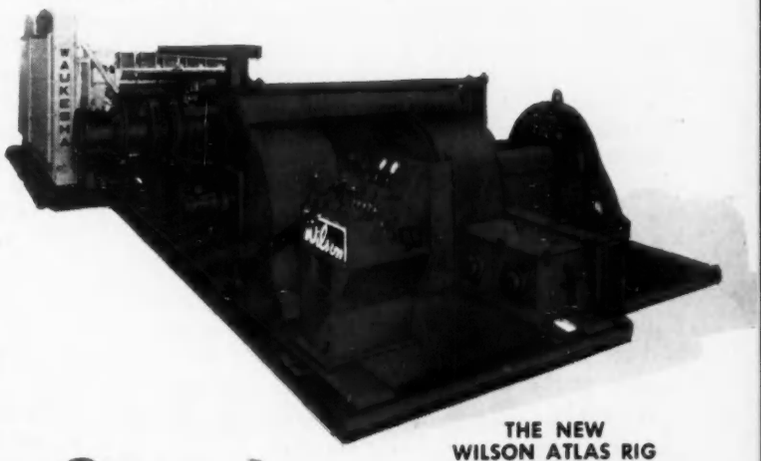

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porosity, though in actual oil reservoirs there may be a practical correlation between these factors and tortuosity factor in a large percentage of cases. One would expect for most rocks that tortuosity would be large where porosity is low, and relatively small where porosity is great, its minimum possible value being one.

Secondly, the presence of oil and gas will also influence tortuosity, since these fluids occur not in separate pores as pictured up till now, but mixed with the water, changing the shape and size of the conductive part of the openings, and filling or blocking off some of them (Figure 2C). The two factors into which T can be broken are called the geometric tortuosity, T_r, a fundamental property of the rock itself and independent of saturation, and the saturation tortuosity, N, due to the effect of the oil and gas. Equation (4) thus becomes:

$$\rho_{sz} = \frac{N T_r \rho_c}{S_w \Phi} \qquad (5)$$

Geometric tortuosity, as defined up to this point, is a constant for a given rock, but saturation tortuosity depends on the amount of oil and gas present, and on how the oil is distributed in the rock. In particular, it would be expected to be very different for an oil wet sand than a water wet sand. Where the rock is completely water saturated N must have the value 1.

Effect of Conductive Solids

Conduction through such a rock would be completely electrolytic. If the rock contains also some conducting minerals (shaded in Figure 2) then resistivity would be reduced. The conductive solids would bypass some of the more tortuous pores, decreasing the effective tortuosity. Thus resistivity would be reduced. The amount of bypassing would depend on the ratio of the resistivity of the electrolyte to that of the conductive grains. The greater this ratio, the greater the fraction of the current carried by the minerals. This influence is not provided for in equation (5). One might suppose that the effect of the bypassing conductive minerals is to make T_r a variable. One would expect it to be a function of the amount and distribution of these minerals in the rock, and on the ratio of their resistivities to that of the electrolyte.

If the rock contained also some clay, or material behaving similarly, the conduction would be further altered by its effect on the number and freedom to move of the charged particles in the electrolyte. Most commonly the number of particles would be increased. The clay, then, adds conducting material in parallel with what already exists. The effect of this in-parallel system is, in general, a decrease in the resistivity of the electrolyte. However, since the added ions are not evenly distributed through the water, but are in part restricted to a thin layer adjoining the clay particles, the dependence of rock resistivity on this element of the conductive system must be expected to be more complex than what we have considered so far.

To get a complete picture of the conduction one might look upon each pore as consisting of two little resistors in parallel, one representing the normal electrolyte, and the other providing for the clay effect in that pore. Each pair of resistors would be connected at either end to other pairs of resistors (pores), and additional interconnections would be provided by the bypassing effect of any conductive minerals present. The magnitude of each resistance would depend on the pore dimensions, the amount and nature of the salt present, and the composition and distribution of the active minerals surrounding or suspended in the electrolyte. The ideal way to approach the problem might be to try to solve for the resistivity of such a system using the mathematics of network analysis as developed by communication engineers. This would be a difficult problem, but not necessarily an impossible one. Solutions could easily be obtained for certain simple cases. As the complexity of the network pattern increased more rock variables could be taken into account. Desirable though such an approach is, it remains to be tried; and is hence beyond the scope of the present elementary treatment.

It is, therefore, necessary to resort to an empirical approach to get a better approximation than that given by equation (5). With present knowledge account can be taken of the effect of only one more factor, the clay-effect. Study of rock composition has led to the belief that this is much stronger than the bypassing effect, which is possibly negligible in most common oil reservoir materials.

The degree to which the theory developed above agrees with experimental observation will be treated in the second part of this paper.

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(First of Two Parts)

Running Pipe

CONTINUED FROM PAGE 112

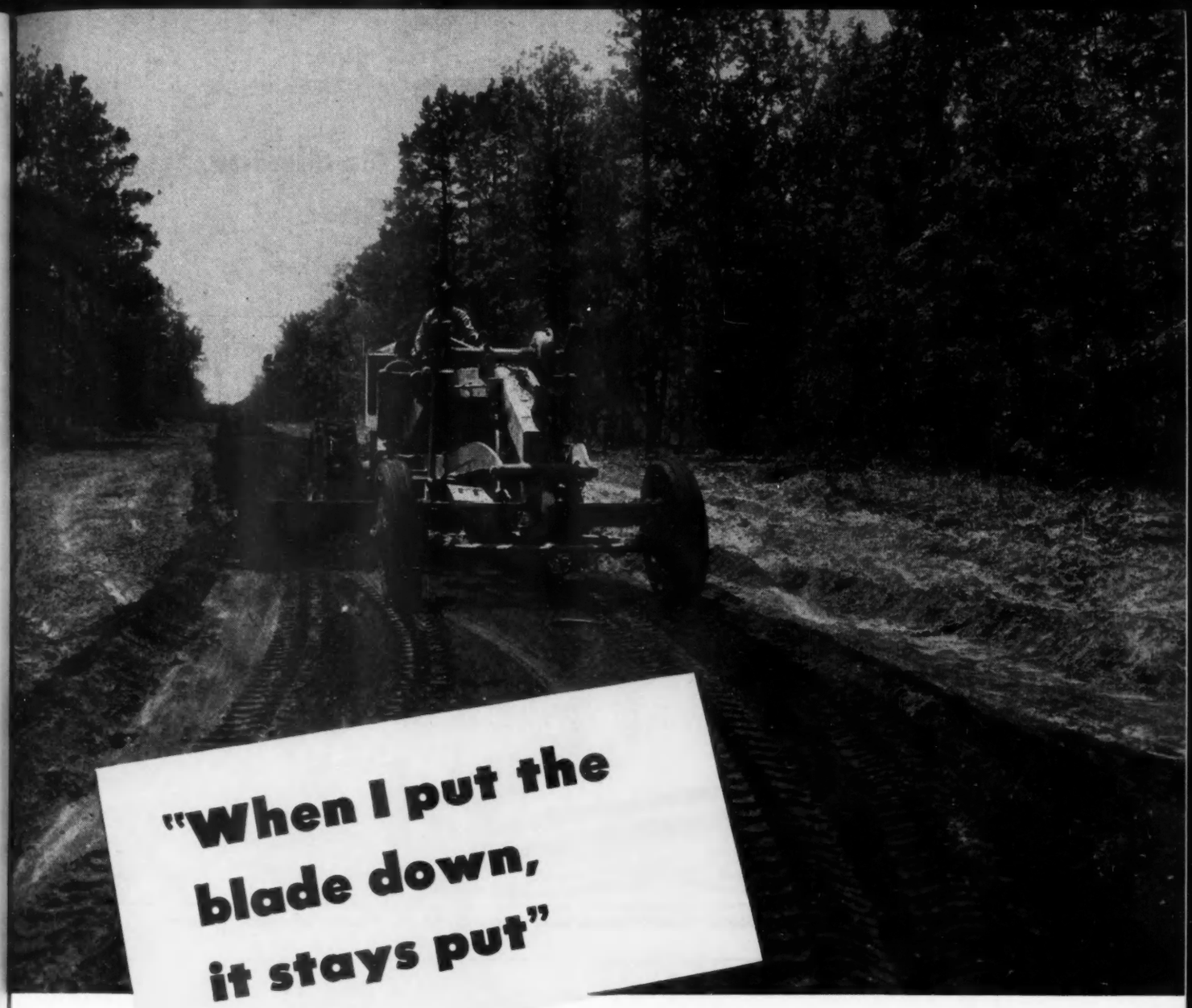
nected to the bottom of the traveling snubbers at two points running down and around two sheaves which are anchored to the well control equipment and up to the blocks. An upward pull on the blocks results in a downward movement of these snubbers and slacking off on the blocks allows the weights to cause the snubbers to rise.

As the tubing attempts to come out of the well, it is held by closing the stationary snubber slips around the pipe. The blocks are then raised which brings the open traveling snubbers down along the pipe to a point near the stationary equipment and the traveling gripping device is closed on the pipe. The stationary device is released and the unit operator permits the pipe to come out of the well by slacking off on the blocks. As the limit of travel is reached, the stationary equipment is again closed and the process repeated. The packer is lubricated out of the well and the remainder of the pipe removed, closing the master gate as the bottom of the string clears the gate valve.

To rerun the dressed string, the process is reversed and the pipe is snubbed down to the point where its weight overcomes the pressure force acting on it and then run with the snubbing equipment out of action by lubricating the collars through the preventors as previously described.

The lower preventor is used as a safety head and permits repacking or changing ram size on the preventors above it as well as providing extra lubricating space if needed.

While it is difficult to estimate the exact time to perform well work, there are many cases on record in which a 10,000-foot string of tubing has been round tripped in from 60 to 70 hours working time. Recently two strings of tubing, each approximately 11,300 feet long were round tripped for a West Texas operator, one in 66 hours, the other in 76 hours including rig-up and tear-down time. Neither well was off production more than six days. Computing the total costs of the workover, this work was accomplished at a substantial saving for the operator as compared to costs of using mud to kill the wells. More important, any possibility of damaging the producing zones of the dually completed wells was eliminated completely.



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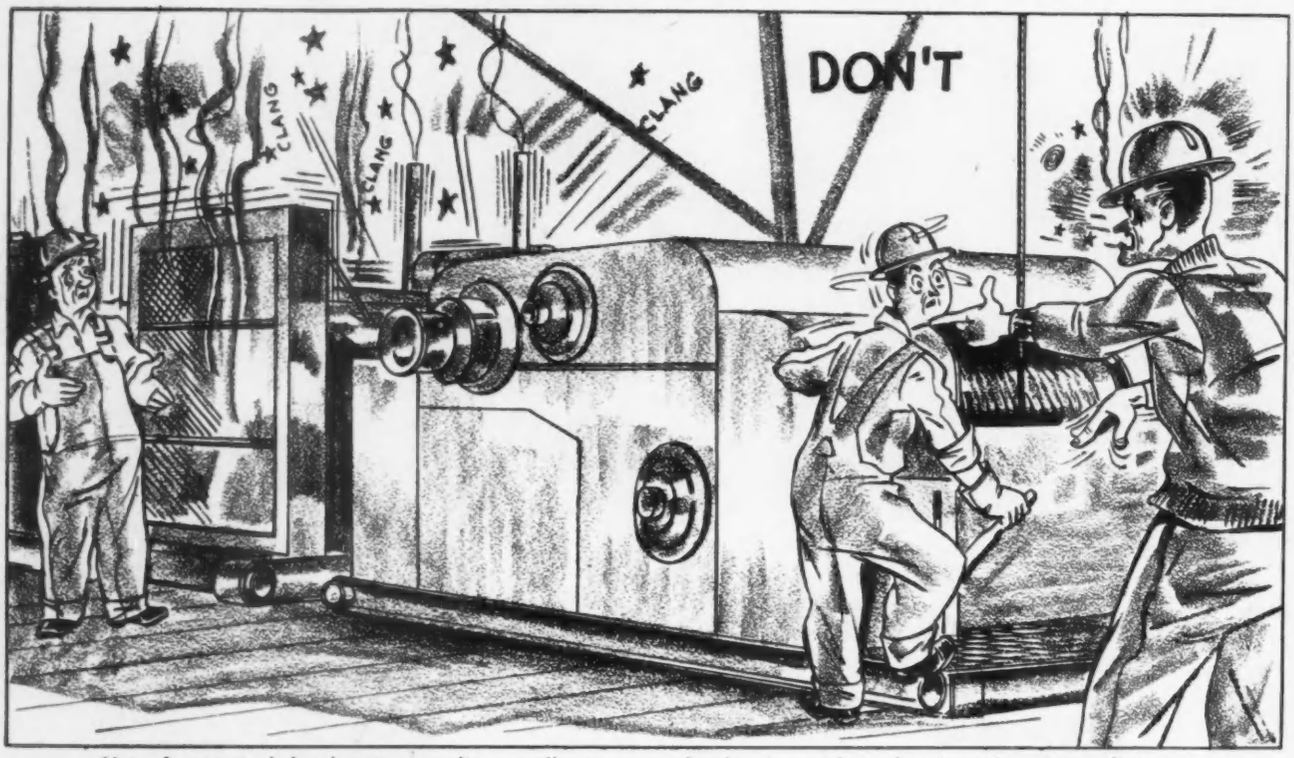
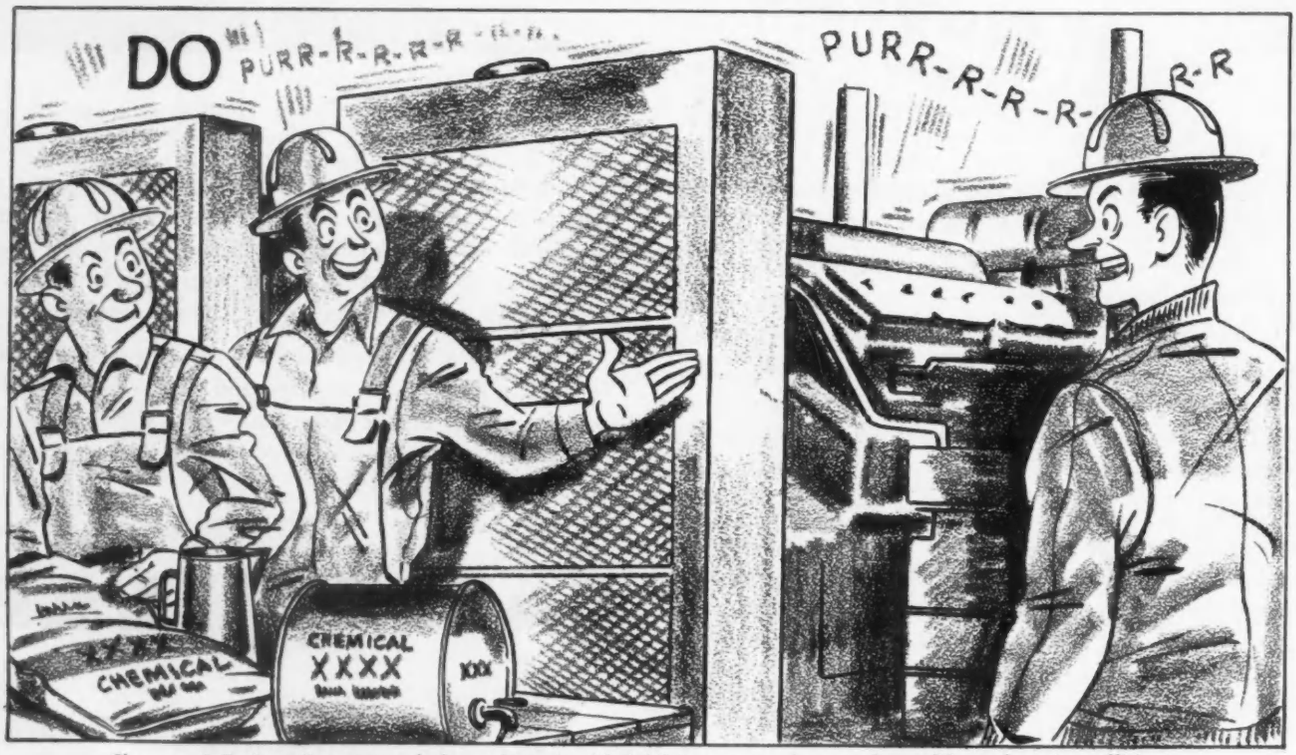


Use of untreated, local water supplies usually causes early clogging and overheating of engine radiators.



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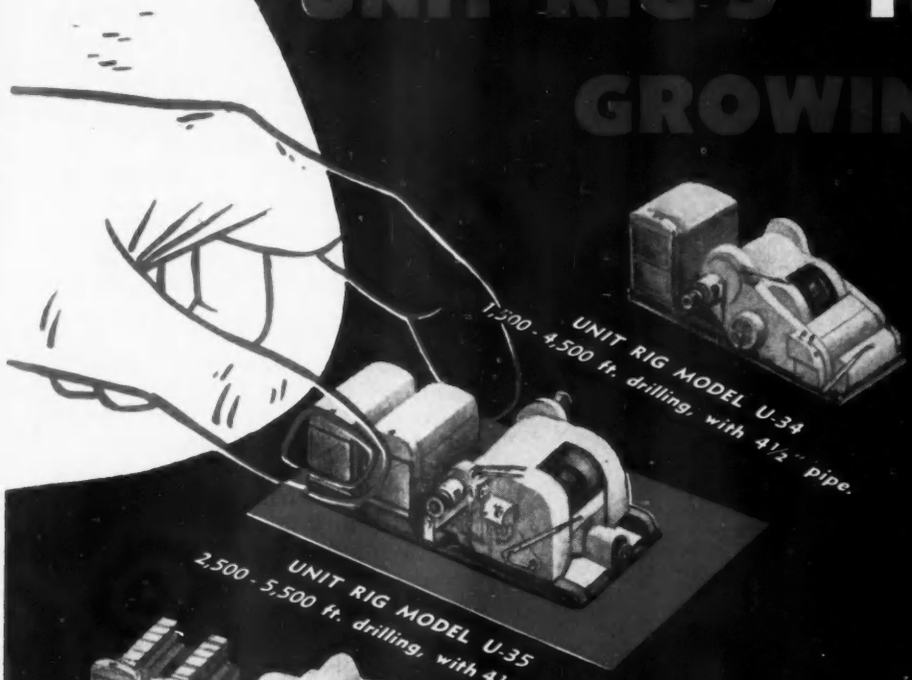

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This rig operating for Shell Oil Company in the Glendive field depicts a typical winter scene in Williston Basin.

How They're Whipping Williston's Winter

Cold weather has added some new wrinkles to drilling in nation's newest oil province.

By LLOYD W. SVEEN, Oil Editor,
The Fargo Forum, Fargo, North Dakota

THE MERCURY doesn't drop quite as deep as the wildcat wells in the Williston Basin, despite what Gulf Coast drillers say, but Winter in North Dakota and Montana has added new wrinkles to drilling in the nation's newest oil province.

Winter can be spectacularly severe but it can be whipped. In North Dakota, for instance, Weather Bureau records show temperatures fall below zero about 50 days each year in the central part of the state and the average January temperature in the northern part of North Dakota and Montana ranges from 4 to 6 above zero, the central area from 8 to 10 and the southern counties from 12 to 14—the average rising because of chinook winds, warm winds fanning eastward from the leeward side of the Rocky Mountains.

Temperature fluctuations can be large; sometimes a drop of 60 degrees occurs in 24 hours; a chinook can raise the temperature 75 degrees from one day to the next. And again, winter can settle down grimly as in 1936, when all records were broken for continuous cold. At Williston, N. D., the highest temperature recorded between February 5 and 17 was 9 below zero and Weather Bureau records show the coldest temperature recorded was 50 below with the average for the 13 days 26 below zero.

And in the same gloomy winter, the temperature at Devils Lake, N. D., went below freezing November 27, 1935 and did not rise to the freezing point until March 1, 1936—96 days which U. S. Meteorologist F. J. Bavendick of Bismarck, N. D., says probably is without parallel in the weather history of the United States for a first-order weather station.

Happily, such records once set are seldom broken and most were made long ago. A year ago Williston's winter was comparatively mild; geologists who had become used to seeing a core freeze instantly when it was punched out of a core barrel were complaining that they had to hustle again to can the core before oil shows leaked.

Wind Hazard. Cold isn't the worst angle to Williston's winter, for warm clothing keeps it out and the air is so dry the cold is not penetrating. Snowstorms and blizzards are the chief hazards and obstacles.

A blizzard is a cold, high wind laden with fine snow—a combination which sometimes can drive snow into buildings through very small cracks.

Blizzards come suddenly and although forecasting is good the Weather Bureau leans to the pessimistic side just to make sure it won't miss a blizzard, for only the tornado and hurricane are more dangerous to human and animal life. While other regions have heavier, wetter snowfalls than Williston's blizzards, they are not as spectacular; it is impossible to see ten feet away when a blizzard is at its worst and attempts to keep highways open are useless until the storm subsides.

While a motorist can't see the distinction, the Weather Bureau says wind which whips up snow on the ground is not a blizzard unless snow also is falling from the clouds, and blowing snow that rises less than six feet off the ground is merely drifting snow.

North Dakota averages several blizzards a year but only three or four widespread, severe blizzards occur every decade with loss of life being largely due to these lapses which cause people to forget the dangers. March blizzards are the most treacherous in this respect.

All of this is discouraging, and the tales resulting from a once-in-20 years reading of 50 below zero and a three-day blizzard are remembered far longer than the uneventful days when life goes on as usual. Likewise, the stories told of the winter of 1950-51 when Amerada Petroleum Corporation of Tulsa was drilling the North Dakota wildcat Clarence Iverson 1,

are far more interesting than today's routine operations.

Thus, while the Loffland Brothers Company rig which drilled the Clarence Iverson, and which became the North Dakota discovery well, was winterized in haphazard fashion and there were times when there was no certainty the lonely wildcat could continue drilling in a tough winter, winterizing has progressed to the point where last winter, of four Montana wildcats only one rig lost 1.1 day because of weather.

How It's Done. Winterizing starts by enclosing at least three girts of the derrick with metal sheathing on a two by four framework; the derrick man usually gets canvas around the fourble board girts.

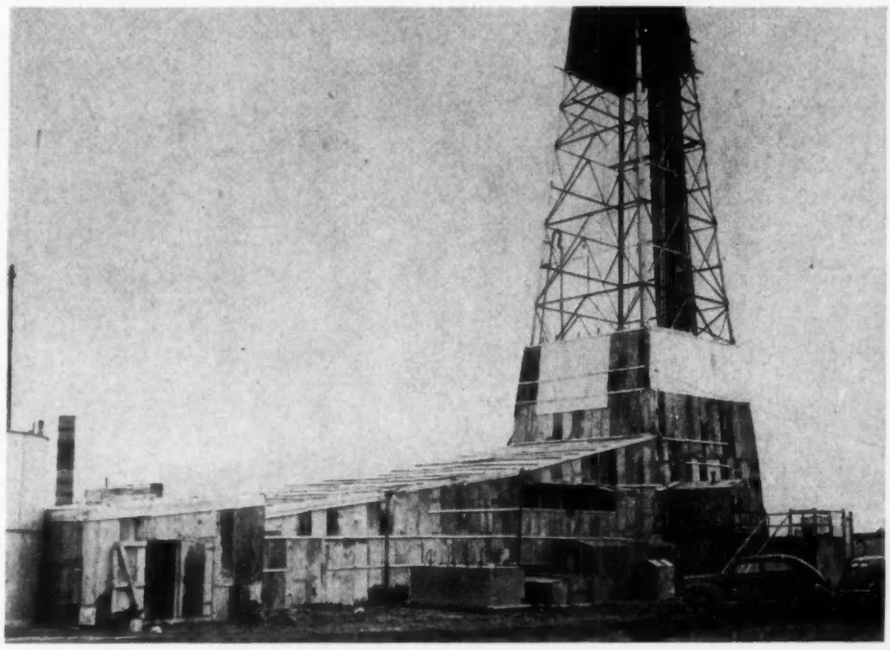
Drawworks are completely enclosed, including roofing, with a steam boiler installed at the rear. The water well also is drilled at the rear of the rig so it is enclosed; water and steam lines are laid in the same trench to prevent water lines from freezing. Steam is exhausted into outside water tanks, the shale-shaker is enclosed and wells drilled below 6000 feet use tank-type mud pits which also are enclosed.

Deeper tests, however, get such high temperatures pits won't freeze even though unprotected; constant circulation prevents any difficulty. In fact, an enclosed pit for a test below 6000 feet is a handicap because steam fogs up the housing and condenses into frost.

Heat from engines and steam lines makes the derrick floor a reasonably comfortable place to work despite the open top; it's a different story for the derrick man. A steam line is run up to the fourble board but his windbreak isn't much protection; Arctic clothing is a must and many a time the derrick man comes down after a trip with his hooded head and face encrusted with ice, only slits for the eyes and mouth unfrozen.

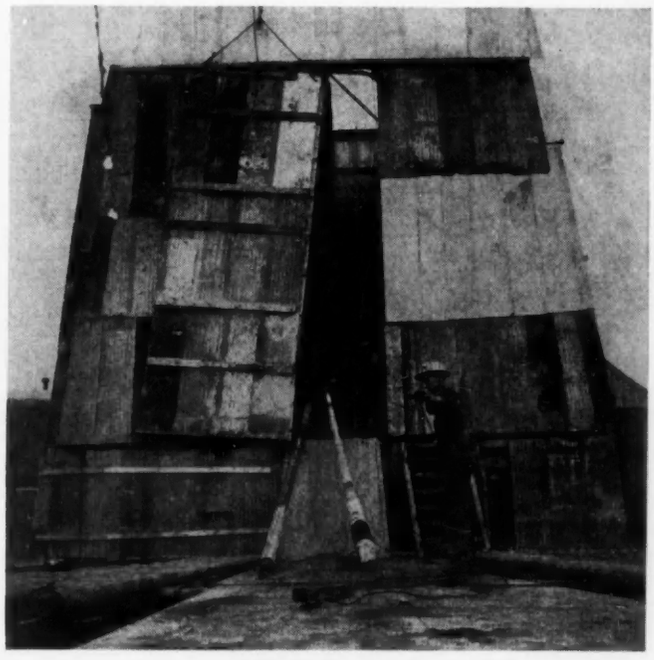
If a blizzard maroons a rig, drilling doesn't stop for snug bunk houses, well-equipped with many days supply of food, are provided for anyone caught on location. By keeping one or two men at the rig while others of the tour sleep, hole is made until time for a trip when all five turn out; thus one tour usually can keep going until the storm subsides. If a drill stem test or other contract job pops up the driller makes his now-rare log: "Waiting on weather"; when the snow stops swirling, bulldozers lead a parade of drillers, roughnecks and service trucks and business goes on as usual. At $100 an hour rig time business as usual is a desired goal.

Short wave radio is vital in spanning Williston's distances but never so important as in winter when despite

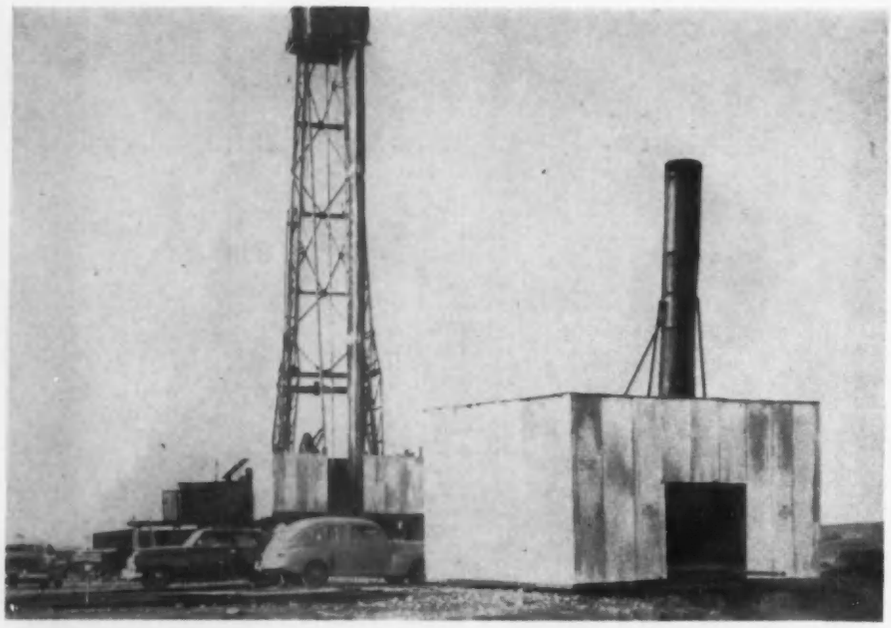


Completely winterized, this rig is ready for the Williston Basin. Note boiler house at rear of rig. Canvas protects derrick man.

A. Jacobsen, president of Amerada Petroleum Corporation, inspects snug interior or a winterized rig in North Dakota.



A massive door is opened to pick up pipe or a test tool as shown in this picture of a rig in North Dakota's Beaver Lodge field.



Topography did not permit locating boiler at rear of this rig in Glendive field of Montana, so boiler house was placed in front. Steam lines run to jack-knife rig, which is in process of winterizing.

. . . . Williston sidelights

Early Zion, a Loffland toolpusher, and A. D. (Blackie) Davidson of the Amerada Production Department are two who can vouch for the hazards of the Williston winter. They tell of a blizzard which marooned them at the Iverson well until their food supply consisted of a can of beans and an egg. A ski-equipped airplane came to the rescue with a fresh food supply.

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An added note on the expense of winter drilling in Williston: the bill for gloves goes up because the roughnecks have to change constantly. If they don't, the gloves freeze to their hands.

—Photo of Montana winter scene courtesy of Shell Oil Company. All other photos by **The Fargo Forum.**

This derrick is being winterized to drill discovery well in North Dakota's Croff field. Metal sheathing over a framework of two-by-fours encloses rig. Boiler is at rear and water well beside it.

all precautions a car might get caught in a storm or a toolpusher needs orders fast. Oil field cars and trucks are equipped with snow-grip tires, chains, emergency heat and rations, blankets and extra clothing. Anyone trapped by a blizzard can ride it out in safety, if not the utmost in comfort, by staying in his car until help arrives.

Winter offers other problems: how do you make location in frozen ground? After snowdrifts are cleared, straw, crude and lignite can be burned for 72 hours to thaw the ground so pits and cellars can be dug, or dynamite can be used. Whatever method is used is slow and expensive; that kind of operation can run up a bill of $6000 to $9000 before a rig is moved on location.

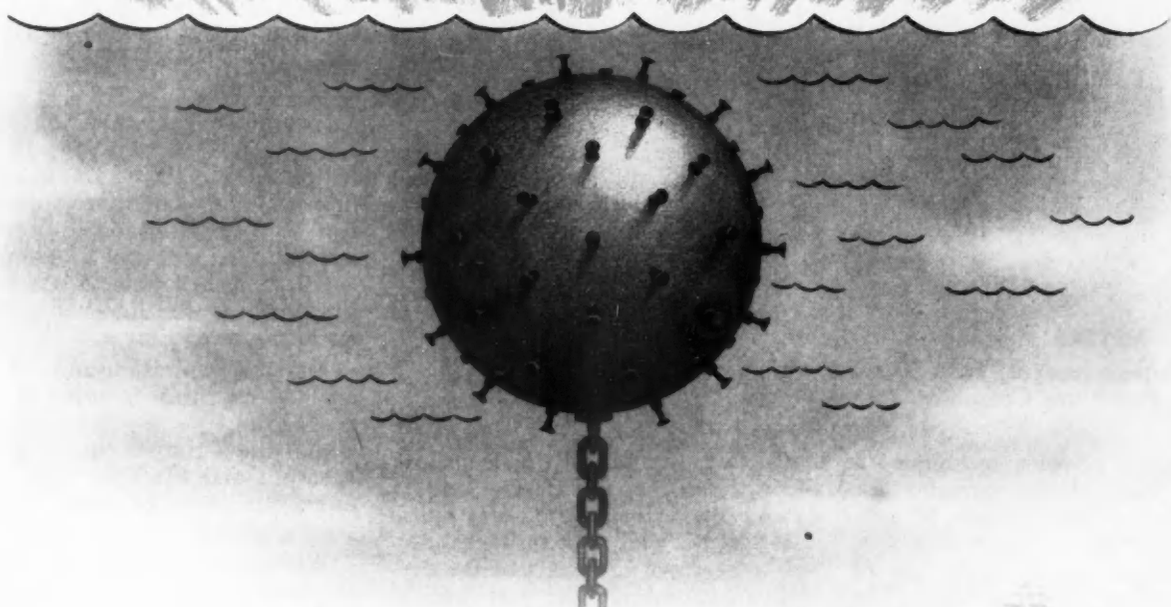
Planning Pays. However, an operator engaged in drilling a field, such as Amerada is doing in the Beaver Lodge and Tioga fields, can cut that bill by more than $3000 by planning ahead. Last September Amerada began preparing locations for wells to be drilled during the winter, clearing ground, building roads and digging pits and cellars at a furious pace until 50 locations were prepared before snow came. With a tall pole marking sites, all that must be done is to clear out snow and move in a rig.

With most of the development wells being drilled by jacknife rigs, sheathing is attached in sections for easy dismantling and reassembly. Rigs and housing, bunk houses and geologists' shanties all are skidded to new locations with a minimum of time loss. The Noble Drilling Company rig which drilled the discovery well in Tioga field has been skidded ten miles without removing sheathing.

A year ago wells drilling during the winter all were scheduled to Devonian or deeper below 10,000 feet. Wildcatters in search of flank discoveries below 5000 feet folded up when the first snows came in late October. Winter came late to the Williston Basin this year, with the ground clear until late in November, saving the oil industry thousands of dollars in snow removal bills alone and resulting in another dozen or so shallow tests being drilled during the long, mild Indian summer.

But this year the basin is so hot, with encouraging oil shows at 3500 feet in Manitoba and northern North Dakota, that wildcatters are pushing their search for shallow oil through the winter even though winterizing can take longer than drilling a well. Costs are correspondingly less than the deep drilling near the center of the basin; the winterizing bill for Continental and Pure's Leuth 1 wildcat in North Dakota's Wells County was $2000, including boiler.

LIVE OR DUD?



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FORMATION AND CASING TESTING — JOHNSTON

Cutoff Technique Reduces Time Requirements 50%

Here's a simple method involving use of discarded cable tool equipment.

By R. D. MEYERS
Drilling Superintendent, West Texas Division,
Magnolia Petroleum Company

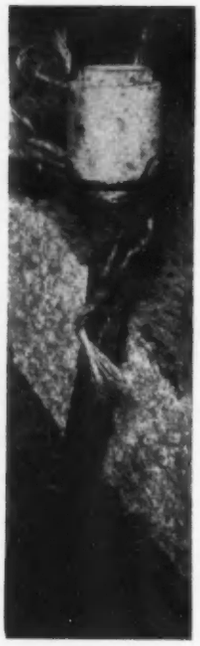

FIGURE 1.
A socket or welded nubbin is attached to the end of the wire rope segment, anchored to derrick substructure or drawworks tiedown, to eliminate possibility of line slipping through floor or clamps sliding.

WIRE LINE CUTOFF technique, a practice responsible for extended line life, can be speeded at least 50 percent through the adoption of a very simple method involving the use of discarded cable tool equipment. The outlined method is intended for rigs with grooved drawworks drums operating under standard derricks. However, the same basic principles can be modified to suit all types of rigs and derricks.

Organization and teamwork are the most important factors in reducing the time required to cut a drilling line. This procedure will eliminate the time-consuming task of laying the traveling blocks to make a wire rope cut.

Cutting Equipment. A length of old drilling line, sufficiently long to extend approximately ten feet above the floor, is clamped to the drawworks tie-down or a part of the derrick substructure. The free end is fed through the floor in front of the drum. It is recommended that the free end be rigged with either a socket or welded "nubbin" to keep it from falling through the floor and also to prevent the wire line clamps from slipping off.

Cutting Procedure. The free end of this line is clamped to the fast line in the derrick. The blocks are slacked off until the line carries the entire block weight. Then slack is rolled off the drawworks drum and the line is cut in the conventional manner. Any amount of line can be cut off, depending on the position of the traveling blocks in the derrick.

Slipping Equipment. An inverted cable tool drilling clamp is installed on the dead line between the regular tie-down and the derrick floor. The clamp is swung from the derrick substructure with a ⅝-inch wire line fastened to the clamp bail and the substructure. The clamp is tied to the skid sill by means of 1¼-inch drilling line securely clamped.

Slipping Procedure. The outlined procedure applies primarily to the rigs having grooved drawworks drums. Line on one-half the drum, which varies from 15 to 18 wraps, is satisfactory as the pick-up point. At present, it is the practice to slip two times between cuts.

Example. A drum is lagged with 32 grooves. After cutting, 15 to 16 wraps will remain on the drum. The first slip will be approximately 50 feet or 7 to 8 wraps. In turn, the second slip will be a comparable length. It is desirable to cut and not slip again so the line will not cross on to the second layer.

Again, organization and teamwork are the essential factors. Everyone should have a definite assignment with which he is quite familiar. Measure and mark on the reel the amount of line to be pulled on. At this point attach a wire line clamp.

While some crewmen are removing the weight indicator, another can be loosening the wire rope tie-down. When the weight indicator is loosened, the extra line is pulled on to the drawworks drum while one man is keeping it snubbed with the cable tool clamp. When the line is slipped, always add an amount of line that will change the pickup point one-quarter of a turn.

•

This idea is quite simple and inexpensive to use and the operator will be rewarded through its application. When a rig is not prepared properly for wire line cutting and it is necessary to lay down the traveling blocks, time is lost on this simple task so important in the role of extending wire line life. Streamlining of these supposedly simple chores is often more important from the standpoint of time and money saved. The repair, movement or adjustment of heavy equipment generally is expedited. But the drilling tools operator often will overlook the time which can be saved on the smaller jobs.

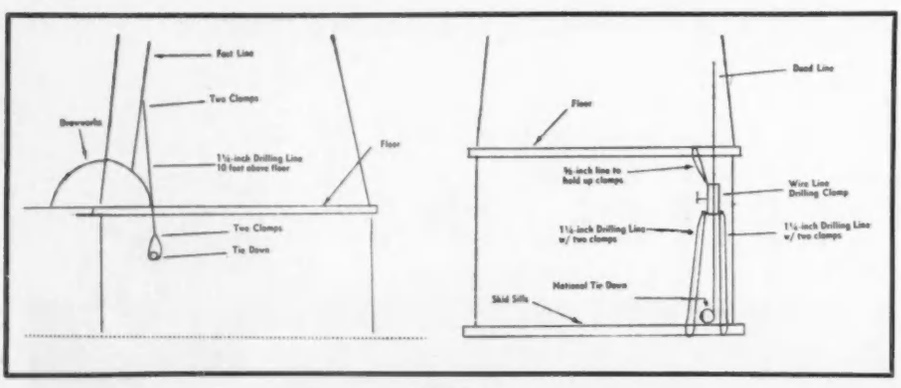

FIGURE 2.
Diagram of wire line cutting rig.

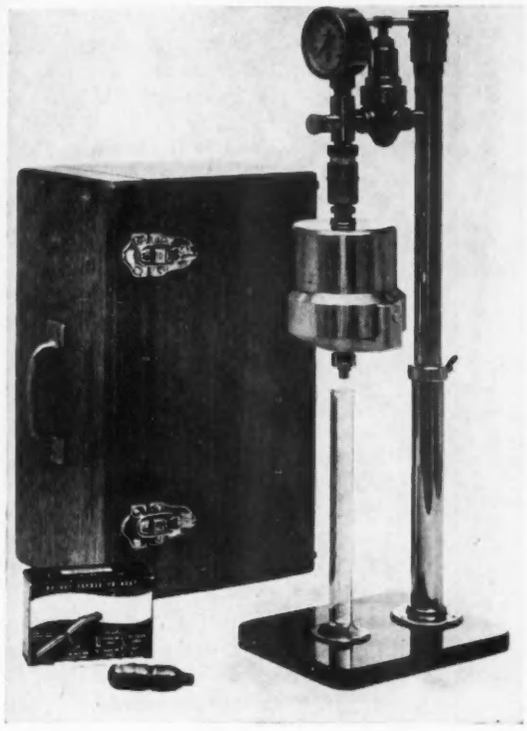

FIGURE 9.
Fann filter press, field model.

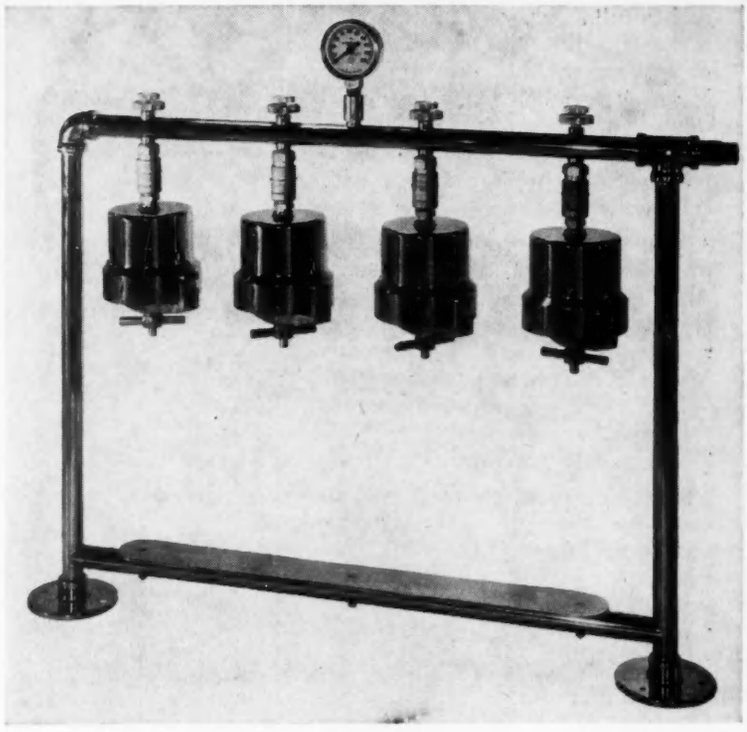

FIGURE 10.
Fann filter press, laboratory model.

How to Train Mud Engineers

- **Technique of filtration, pH and sand determination described.**
- **Accurate measurement and control of these factors assures the presence of efficient drilling fluid at all times.**

Part 2

By FRED CHISHOLM and B. Q. GREEN
Magnet Cove Barium Corporation, Houston

Section 3
Filtration

Instruments: The filtration, or wall building property of a mud, is determined by means of a filter press. The test consists of determining the rate at which fluid is forced from a filter press containing the mud sample under specified conditions of time and pressure, and measuring the thickness of the residual solid film deposited on the filter paper by the loss of fluid. Two low pressure filter presses are currently used in the field, viz., the Fann filter press and the Baroid filter press. Both presses meet the API specifications, by using Whatman No. 50 filter paper, or an equivalent grade, and having a filtration area of seven square inches.

Fann Filter Press, Field Model

A. Description: This instrument (Figure 9) consists of a mud cell assembly, pressure source, pressure regulator and gauge, on a telescoping support. The cell is attached to the regulator by means of a quick-disconnect coupling, and is closed at the bottom by a yoke and screw device, forcing a sheet of filter paper against a neoprene O-ring. Pressure is supplied by a small cartridge containing carbon dioxide gas. A bleed-off valve is provided to release pressure prior to uncoupling the cell.

B. Procedure:

Loosen set screw on telescoping standard one-half turn, and raise instrument to operating height.

Disconnect filter cell from regulator by pushing coupling sleeve upward and turning cell slightly to the left. Remove bottom of filter cell by loosening large screw until bail can disengage from pins on cell body. Fill to within ½ inch of gasket ledge with fluid to be tested, and be sure that ledge is clean with large O-ring in place before inserting filter paper. Replace bottom, tighten screw and couple cell to regulator.

Cover tip of pressure cartridge with a *very small* amount of silicone grease, remove cap at top of standard and insert cartridge in holder. After cartridge has been punctured by tightening cap, back off about ¼

turn to allow gas to pass the puncturing pin. **Caution:** Do not remove cartridge from holder until pressure has been completely exhausted. To do so may damage the scaling gasket. Unwanted pressure may be released by coupling empty filter cell to instrument.

Adjust regulator for the desired pressure, and proceed with the test. After test is completed, back off the regulator T-screw and bleed pressure gently with needle valve located just below pressure gauge. A relief valve, located on left side of regulator, will blow if pressure exceeds 200 pounds per square inch.

Clean instrument thoroughly after each run, and blow through top coupling adaptor to make sure it is clean for the next run. Put a fresh piece of filter paper in place to keep screen from sticking to gasket.

Report the volume of filtrate in cubic centimeters (to 0.1 cc) as the filter loss at 100 psi at the average temperature of the mud during the test, in degrees Fahrenheit. If a time other than the standard 30-minute interval is used, the time in minutes must be specified.

Wash the filter paper with a gentle stream of water. Report filter cake thickness in thirty-seconds of an inch.

Fann Filter Press, Laboratory Model

A. Description: This instrument (Figure 10) consists of a tubular frame with quick-disconnect couplings attached to the header to accommodate from 2 to 6 cells. The mud cell assembly is the same as for the field model press. Each cell can be operated independently of the other by means of a dual purpose needle valve at each station. One section of the valve controls inlet pressure, and the other is to bleed off pressure at termination of the test.

B. Procedure:

Disconnect filter cell by pushing coupling sleeve upward and turning cell slightly to the left.

Remove bottom of filter cell by loosening large set screw until bail can disengage from pins on cell body. Fill to within ½ inch of gasket ledge with fluid to be tested, and be sure that ledge is clean, with large O-ring in place, before inserting filter paper. Replace bottom, tighten screw and couple cell to filter press header.

Adjust regulator to the desired pressure and back off the dual needle valve.

After test is completed, reseat the dual needle valve and bleed pressure gently, by backing off the upper half of the dual needle valve.

Clean instrument thoroughly after each run, and blow through cell coupling adaptor to make sure it is clean for next run.

Report filter loss and filter cake thickness as described for field model.

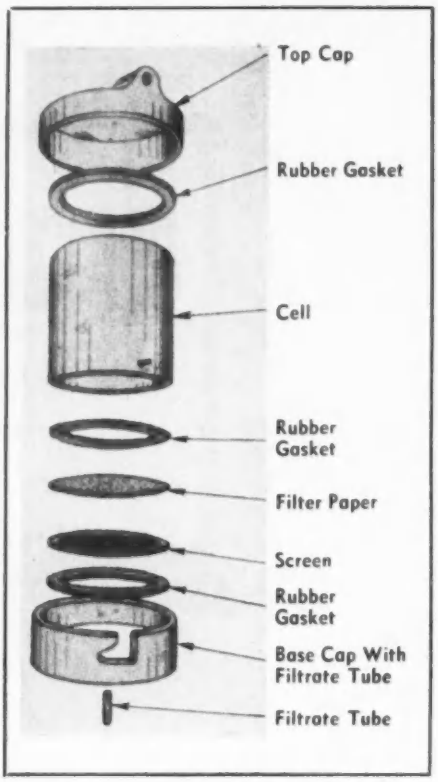

FIGURE 11.
Baroid mud cap assembly.

Baroid Filter Press

A. Description: The filter press (Figures 11 and 12) consists of a screw-press frame and filter cell or mud cell assembly. The top of the cell is fitted with a gasket and a machined cap which has a small hole for admission of a pressure medium. The bottom of the cell is closed by a sheet of Whatman No. 50, or equivalent, filter paper, backed by a wire screen and a bottom cap with necessary gaskets to provide an effective seal.

B. Procedure:

Assemble the cell in the following sequence: bottom cap, gasket, screen, filter paper, gasket and cylinder. The assembly should be dry.

To conserve pressure medium, fill the cell with the mud to be tested to within ¼ inch of the top. Place the cell in the frame, put on the top cap, making sure the gasket is in place, and tighten the T-screw to complete the assembly. Place a dry graduated cylinder under the delivery tube to receive the filtrate. Close the relief valve and apply a pressure of 100 plus or minus five psi. The test period begins at the time of application of pressure.

After 30 minutes, shut off the applied pressure and open the relief valve. Measure the volume of filtrate.

Report the volume of filtrate in cubic centimeters (to 0.1 cc) as the filter loss at 100 psi, at the average temperature of the mud during the test, in degrees Fahrenheit. If a time other than the standard 30-minute interval is used, the time in minutes must be specified.

Remove the cell from the frame (first making certain that the pressure has been relieved) and pour off the mud. Carefully separate the base plate from the cylinder and wash the filter cake on the paper with a gentle stream of water. Measure the thickness of the filter cake.

Report the thickness of the filter cake in thirty-seconds of an inch.

Section 4

Hydrogen-ion Concentraton (pH)

Instruments: Two methods are used for measuring the hydrogen-ion concentration, or pH, of drilling mud: viz., a modified colorimetric method, using pHydrion paper test strips, and the electrometric method, employing the glass electrode. The paper-strip method may not be reliable if the salt concentration is high, and the electrometric method is subject to error in solutions containing high concentrations of sodium ions, unless a special glass electrode is used, or unless suitable correction factors are applied in using the ordinary electrode.

pHydrion Paper

A. Description: The pHydrion paper (Figure 13) is impregnated with dyes of such nature that the color is dependent on the pH of the medium in which the paper is placed. A standard color chart is supplied for comparison with the test strip. pHydrion papers are available in a wide-range type, which permits estimation of pH to 0.5 unit, and in narrow-range papers, with which the pH can be estimated to 0.2 unit.

B. Procedure:

Place a one-inch strip of indicator paper on the surface of the mud and allow it to remain until the liquid has wet the surface of the paper and

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the color has stabilized (usually about one minute).

Compare the color of the upper side of the paper (which has not been in contact with the mud solids) with the color standards provided with the test strip and estimate the pH of the mud.

Report the pH of the mud to the nearest 0.5 or 0.2 unit, depending upon the range of the test paper employed.

BECKMAN pH METER

A. Description: The Beckman pH meter (Figure 14) consists of a glass-electrode system, an electronic amplifier, and a meter calibrated in pH units. The electrode system is composed of a glass electrode, which consists of a thin-walled bulb made of special glass within which is sealed a suitable electrolyte and electrode, and a reference electrode, which is a saturated calomel cell. Electrical connection with the mud is established through a saturated solution of potassium chloride, contained in a tube surrounding the calomel cell. The electrical potential generated in the glass-electrode system by the hydrogen ions in the drilling mud is amplified and operates the calibrated meter which indicates the pH.

B. Procedure:

Follow instructions on the instrument to put the amplifier into operation and standardize the meter with the proper buffer solution.

Wash the tips of the electrodes, gently wipe dry, and insert them into the mud. Stir the mud about the electrodes by rotating the container.

Caution: Do not allow the electrodes to rub the side of the container.

Measure the pH of the mud according to the directions. After the meter reading becomes constant, which may require from 30 seconds to several minutes, record the pH.

Report the pH of the mud to the nearest 0.1 unit.

Section 5
SAND CONTENT

Instruments: The sand content of mud is estimated by a screen test or by means of a centrifuge apparatus. The screen test, because of its simplicity of operation, is most widely used in the field.

SAND CONTENT SET

A. Description: The sand content set (Figure 15) consists of a 2½-inch diameter sieve, a funnel to fit the sieve, and a glass measuring tube marked for the volume of mud to be added in order to read the percentage of sand directly in the bottom of the tube, which is graduated from 0 to 20 percent.

FIGURE 12.
Baroid filter press.

B. Procedure:

Fill the glass measuring tube to the indicated mark with mud. Add water to the next mark. Close the mouth of the tube and shake vigorously.

Pour the mixture onto the screen, add more water to the tube, shake, and again pour onto the screen. Repeat until the wash water is clear. Wash the sand retained on the screen to free it of any remaining mud.

Fit the funnel down over the top of the sieve. Invert slowly and insert the tip of the funnel into the mouth of the glass tube. Wash the sand into the tube by means of a fine spray of water. Allow the sand to settle. From the graduations on the tube, read the percent by volume of sand. Report the sand content of the mud in percent by volume.

Section 6
FILTRATE ANALYSIS

Purpose: Chemical tests are made on mud filtrates to determine the presence of contaminants, such as salt or anhydrite, or to assist in the control of mud properties; for example, the test for alkalinity in high pH muds. The same tests can be applied to make-up waters, which in some areas contain dissolved salts which materially affect mud treatment.

ALKALINITY

A. Purpose: Alkalinity or acidity is indicated by pH, as previously discussed, but the characteristics of a mud may fluctuate despite constant pH. This is due to the effect of the varying amounts and nature of the ions present. Moreover, the pH scale is logarithmic. The alkalinity of a high pH mud therefore can vary a considerate amount with no measurable change in pH. Analysis of the mud filtrate to determine the character of the alkalinity is more significant than pH measurement in highly alkaline systems such as red muds and lime-treated muds.

B. Apparatus and materials: Standardized 0.02 normal (N/50) acid solution (sulfuric or nitric acid). Phenolphthalein indicator solution (1 gram per 100 ml of 50 percent alcohol). Methyl orange solution (0.1 gram per 100 ml of water). Titration vessel, 100-150 ml, preferably white porcelain. Two graduated pipettes: one 1-ml and one 10-ml capacity. Glass stirring rod. Glass-electrode pH meter (optional).

C. Procedure:

Measure one or more ml of filtrate into the titration vessel. Add 2 or 3 drops of phenolphthalein indicator solution. If the indicator turns pink, add 0.02 normal acid, drop by drop, with stirring until the pink color just disappears. If the sample is so colored that the color change of the indicator is masked, the end point is taken when the pH drops to 8.3, as measured with the glass electrode. Record the volume of acid used.

Report the phenolphthalein or P-alkalinity as the numer of ml of 0.02 normal (N/50) acid required per milliliter of filtrate.

To the sample which has been titrated to the P end point, add 2 or 3 drops of methyl orange indicator solution. Add standard acid drop by drop, with stirring, until the color of the indicator changes from yellow to pink. Record as M the total volume of acid, in ml, used to reach the methyl orange end point (including that for the P end point). If the sample is so colored that the change in color is not evident, the end point is taken when the pH drops to 4.3, as measured with the glass-electrode pH meter.

Report the methyl orange or M-alkalinity as the total ml of 0.02 normal acid per ml of filtrate required to reach methyl orange end point.

LIME CONTENT ESTIMATION

A. Purpose: Some knowledge of the amount of excess lime present is of considerable value as an aid in controlling the properties of a lime-treated mud. An estimation of lime content can be made based on an

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FIGURE 13
pHydrion paper.

alkalinity titration of the filtrate and of the whole mud. The titration of the mud must be made rapidly to permit titration of calcium hydroxide and sodium hydroxide without interference from calcium carbonate.

B. Apparatus and materials: Standardized 0.02 normal (N/50) sulfuric acid. Phenolphthalein indicator. Titration vessel, 100-150 ml, preferably white porcelain. Two graduated pipettes: one 1-ml and one 10-ml capacity. Hypodermic syringe, 2-ml (optional). Glass stirring rod. Distilled water.

C. Procedure:

Measure 1 ml of mud into a casserole and dilute to about 50 ml with distilled water. A 2-ml hypodermic syringe is satisfactory for measuring out even very thick mud, while a pipette may be used for thinner muds.

Add 2 to 3 drops of phenolphthalein indicator solution.

Add 0.02 normal (N/50) sulfuric acid (or 0.1 normal acid if the lime content is known to be above ten pounds per barrel) rapidly from a burette or pipette, stirring continuously, until the sample first turns from red to the color of the mud. The number of ml of 0.02 N acid divided by the ml of sample taken is called the P of the mud (P_m).

Determine the P-alkalinity of the filtrate (P_f) according to the method given above.

Calculate the lime content as follows:

$0.26\ (P_m - F_1P_f)$ = equivalent calcium hydroxide, pounds per barrel.

where P_m = ml. 0.02 N acid for P of mud

P_f = ml. 0.02 N acid for P of filtrate

F_1 = volume fraction of liquid in mud (see table below)

mud wt. (lbs./bbl.)	F_1
10.0	.89
12.0	.82
14.0	.75
16.0	.68
18.0	.61

NOTE: Commercial lime may range in purity from 50 percent to 90 percent calcium hydroxide. If it is desired to express the lime content in terms of the product in use in the mud, a weighed portion of the lime can be titrated with standard acid and the calcium hydroxide calculated from the relation: 1 ml 0.02 N acid = 0.00074 gram calcium hydroxide.

FIGURE 14.
Beckman pH meter.

FIGURE 15.
Sand content set.

CHLORIDE

A. Purpose: The salt or chloride test is very significant in areas where salt can contaminate the drilling fluid. Such areas include a majority of the oil fields in the U. S. Salt stringers and salt beds are drilled in many areas of West Texas and Oklahoma. Surface make-up water in these areas and along the Gulf Coast may present a problem because of salt content. Salt water flows, especially on the Gulf Coast, can contaminate the drilling fluid in the hole. Salt tests are among the means of detecting these flows. When chloride content exceeds 6000 parts per million, more or less, it is generally necessary to alter the mud program.

B. Apparatus and materials: Silver nitrate, 0.0282 normal, containing 4.7910 g per liter (equivalent to 0.001 g chloride ion per ml), preferably stored in an amber bottle. Potassium chromate indicator solution (2 grams per 100 ml of water). Acid solution—0.02 normal standardized sulfuric or nitric acid. Phenolphthalein indicator solution 1 g per 100 ml of 50 percent alcohol). Calcium carbonate, precipitated, chemically pure grade. Distilled water. Two graduated pipettes: one 1-ml and one 10-ml capacity. Titration vessel, 100-150 ml, preferably white porcelain. Glass stirring rod.

C. Procedure:

Measure one or more ml of filtrate into the titration vessel. Add 2 or 3 drops of phenolphthalein solution. If the indicator turns pink, add acid drop by drop, with stirring until the color is discharged. If the alkalinity has been determined, the same sample may be used for the chloride determination.

If the filtrate is deeply colored, add an additional 2 ml of 0.02 normal sulfuric or nitric acid and stir. Then add 1 g of calcium carbonate and stir. Add 25 to 50 ml of distilled water and 1 ml of potassium chromate solution. Stir continuously while adding standard silver nitrate solution drop by drop until the color changes from yellow to orange-red and persists for 30 seconds. Record the number of ml of silver nitrate required to reach the end point. If over 10 ml of silver nitrate solution are used, repeat the test with a smaller sample of filtrate. (NOTE: If the chloride-ion concentration of the filtrate exceeds 10,000 parts per million, a silver nitrate solution equivalent to 0.01 g chloride ion per ml may be used. The factor 1000 in the equation is then changed to 10,000.)

Report the chloride-ion concentration of the filtrate in ppm, calculated as follows:

$$\text{Chloride, ppm.} = \frac{\text{ml of 0.0282 N silver nitrate} \times 1000}{\text{ml of filtrate sample}}$$

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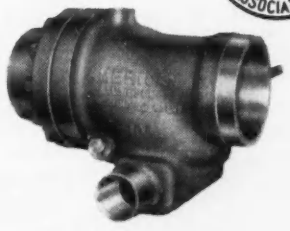

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$$\text{Chloride, ppm.} = \frac{\text{ml of silver nitrate} \times \text{normality} \times 35.457 \times 1000}{\text{ml of filtrate sample}}$$

Calcium — Soap Method For Total Hardness

A. Purpose: Water containing dissolved calcium and magnesium salts is referred to as "hard water." The common evidence of hardness in water is the difficulty of producing a lather in it with soap. In many oil fields, the water available for use is quite hard. As is well understood, drilling clays have low "yields" when mixed in hard water. The harder the water, the more bentonite it takes to make a satisfactory gel mud. In extreme cases it has been found economical to treat the water chemically before using it for mixing mud, but it is not generally considered economical to do this. Frequently, however, where there is a choice of two or more sources of water for the rig, it may be desirable to make a simple test to select the softer of the two.

All field men are familiar with the effects on the mud when anhydrite (calcium sulfate) or "gypy" formations are drilled. Likewise calcium salts are picked up in drilling cement plugs and sometimes in penetrating sections of limy shale. Any extensive calcium contamination results in abnormally high water loss and fast gel rate. The soap test may be used to determine hardness of mud filtrate or make-up water.

B. Apparatus and materials: Standard soap solution, 1 ml = 1 mg $CaCO_3$. Phenolphthalein indicator. Nitric acid, dilute solution. Sodium hydroxide, dilute solution. Distilled water. Two graduated pipettes, one 1-ml, and one 5-ml capacity. Graduated cylinder, 50-ml. Sample bottle, 4-ounce.

C. Procedure:

For mud filtrates, pipette 1 to 5 ml into clean 4-ounce sample bottle, and dilute to 50 ml. For make-up water, measure 50 ml into sample bottle.

Add one drop of phenolphthalein. If pink or red, add sufficient dilute nitric acid to just discharge color, then add dilute sodium hydroxide drop by drop until first permanent pink color develops.

With a pipette, add standard soap solution about 0.5 ml at a time. Shake the bottle after each addition of soap solution.

Continue the above procedure until lather begins to show in the sample. If more than 7 ml of soap solution are required to make a lather, discard the sample and take a smaller portion.

As a lather forms, add soap solution more slowly until a stable lather is established, which will persist for one minute, with the bottle laid in a horizontal position.

The "lather factor," subtracted from the number of ml of soap used before calculating hardness, is the volume of soap solution required to make a lather in 50 ml of distilled water. Usually, it is 0.3 ml; but the "lather factor" should be determined for distilled water of doubtful purity.

Calculate total hardness as follows:

$$\text{calcium carbonate, ppm} = \frac{(\text{ml soap-lather factor})\ (1000)}{\text{ml of sample}}$$

Calcium — Versenate Method For Total Hardness

A. Purpose: The Versenate method for total hardness in water is suggested where more accuracy is desired than can be obtained with the soap method.

B. Apparatus and materials: Standard Versenate solution. UniVer—universal indicator-buffer. Titration vessel, 100-150 ml, preferably white porcelain. Two graduated pipettes: one 5-ml and one 10-ml capacity. Graduated cylinder, 50-ml. Distilled water.

C. Procedure:

For mud filtrates, pipette 3 ml of sample into titration vessel and dilute to 50 ml. For make-up water, measure 50 ml into the titration vessel.

Add approximately 1 g of UniVer and titrate with Versenate solution until the color changes from wine red to blue. In filtrates colored reddish-brown by quebracho, the masking effect of the quebracho tint causes the color change to be from brownish-purple to slate grey.

Calculations:

$$\text{Calcium carbonate, ppm} = \frac{\text{ml standard Versenate} \times 1000}{\text{ml sample}}$$

$$CaCO_3, \text{ppm} \times 0.4 = \text{Ca, ppm}$$

Sulfate — Benzidine Method

A. Purpose: The sulfate ion is found present in all natural waters due to the solvent action of water on the minerals in the earth. Anhydrite (native anhydrous calcium sulfate) is a slightly soluble contaminant encountered in drilling in certain areas. It is often desirable to know the sulfate content of a mud, since the sulfate ion in concentrations above 2000 ppm is detrimental to the mud, causing high viscosity and high fluid loss.

B. Apparatus and materials: Sodium hydroxide, 0.1 normal. Benzidine solution. Phenolphthalein indicator. Distilled water. Flask, 250-ml. Filter paper. Two graduated pipettes: one 1-ml and one 5-ml capacity. Graduated cylinder. Wash bottle.

C. Procedure:

For mud filtrates, pipette 1 to 5 ml into the flask and dilute to 50 ml. For water samples, measure 50 ml into the flask.

Add 10 ml benzidine solution. Mix by rotating flask and filter. Check filtrate with a drop of benzidine solution. If the solution does not remain clear, start over, using a smaller sample.

Rinse empty flask with 25 ml distilled water, and wash the sulfate precipitate by pouring the rinse water over it in three equal parts, allowing each to filter through before adding more. Wash the precipitate twice more with a wash bottle. Place the filter paper containing the precipitate carefully in the flask, and add 25 ml distilled water.

Insert stopper in flask and shake vigorously, until paper disintegrates. Add three drops of phenolphthalein and titrate with 0.1 normal NaOH to a pink end point, which persists for two minutes.

Run a blank sample the same size with distilled water and subtract the amount of NaOH used from the amount used on the original sample. Calculate as follows:

$$\text{Calcium sulfate, ppm} = \frac{\text{ml NaOH} \times 6810}{\text{ml sample}}$$

$$\text{Sulfate, ppm} = \frac{\text{ml NaOH} \times 4800}{\text{ml sample}}$$

REFERENCES

[1] API Code 29, "Standard Procedure for Testing Drilling Mud," May, 1950.

[2] University of Texas, Department of Extension, "Principles of Drilling Mud Control."

[3] Rogers, W. F., "Composition and Properties of Oil Well Drilling Fluids."

(Second of Two Parts)

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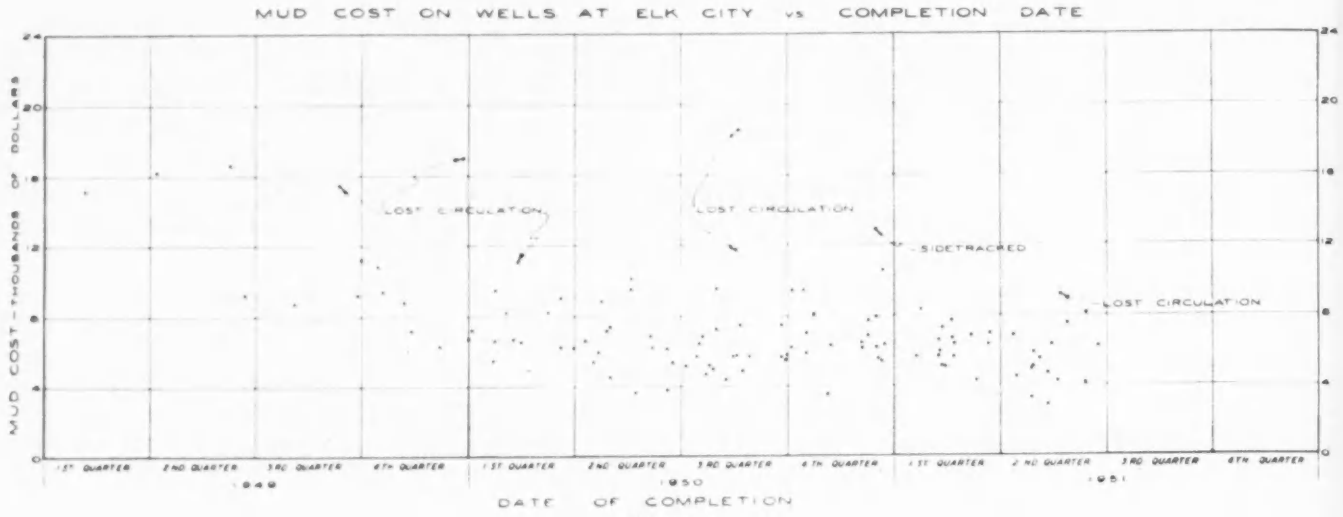


FIGURE 1.

Planning Cuts Mud Costs

Expenses reduced in Elk City field of Western Oklahoma from between $12,000 and $20,000 per well to $5500.

By FRANK S. BELL
Area Mud Engineer, Shell Oil Company, Tulsa

CAREFUL STUDY of drilling mud problems in any field development program pays handsomely in reduced costs and better completions. This conclusion is drawn from Shell Oil Company's efforts in the Elk City field of Western Oklahoma where the average mud cost has been reduced from between $12,000 and $20,000 per well to $5500 per well. This reduction in mud cost is shown graphically in Figure 1.

Such substantial savings, despite mud material price increases, have been possible as a result of several factors:

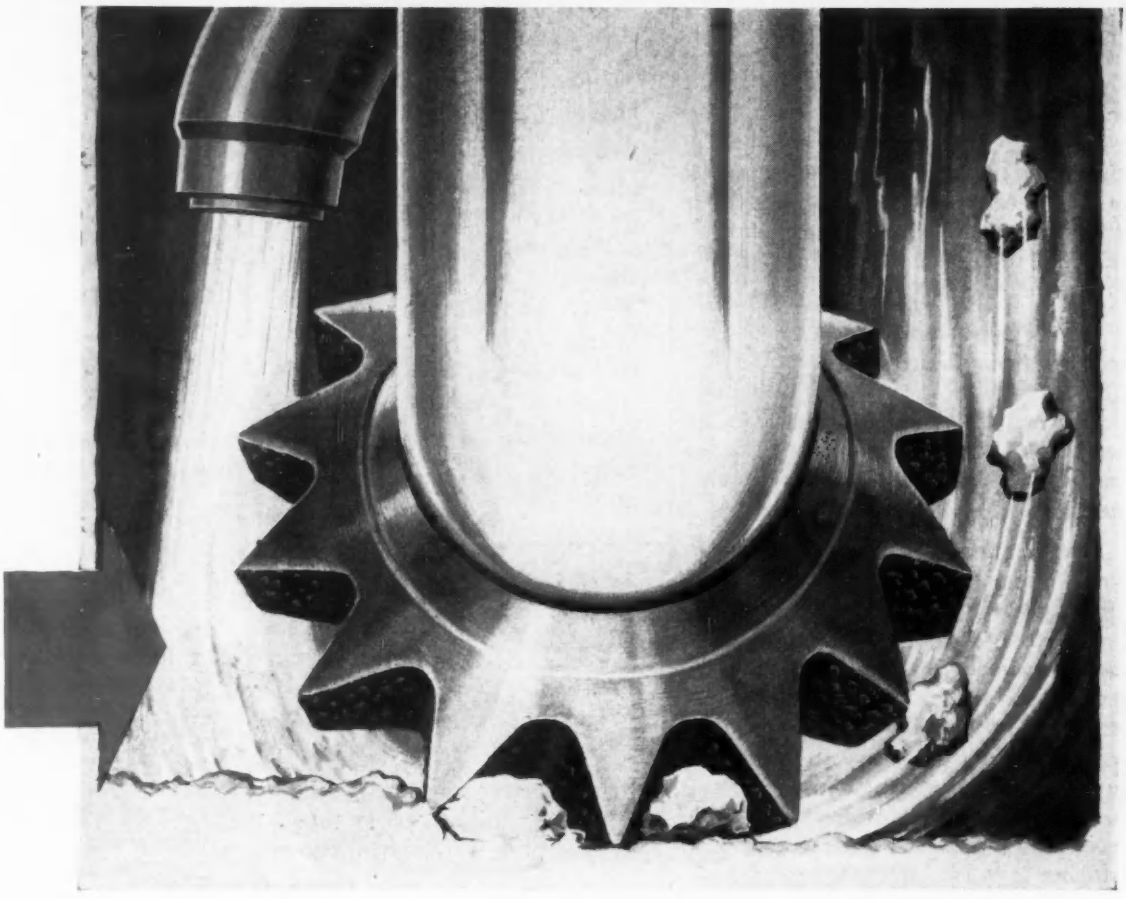
- Continual improvement in the planning of the mud program.
- Using information from previously drilled wells as to zones of lost circulation, and pretreating the mud with lost circulation materials prior to drilling these lost circulation zones.
- Instructing the crews in how to prevent lost circulation and making them more "lost circulation" conscious.
- Salvaging of chemically treated mud from completed wells.
- Reduction in drilling time resulting from improved drilling practices.
- Cooperation of the mud service company engineers and drilling crews in carrying out the mud program.

Elk City is one of the most important discoveries in the Anadarko Basin, Oklahoma. Oil was discovered in November, 1947, in Shell Oil Company's J. G. Walters 1. As of June, 1952, ten drilling rigs were operating in the field, and a total of 192 wells had been drilled and completed by the end of 1951.

Location and Subsurface Geology

The Elk City field is located about five miles south of the town from which it derives its name and covers parts of Beckham and Washita counties in western Oklahoma. The structure is located on the south flank of the Anadarko Basin and is an elongated, narrow anticlinal fold, about nine miles long and two miles wide. The axis of the structure runs northwest southeast and roughly parallels that of the basin. A structural closure of approximately 400 feet has been defined.

The geologic formations at Elk City are of Permian and Pennsylvanian age. The Permian formation outcrops at the surface and extends to a depth of about 6500 feet. The upper 3500 feet are composed almost entirely of red sands, shales and sandy shales, commonly called red beds, except for the Blaine formation. This formation consists of approximately 300 to 400 feet of salt and anhydrite, and is found at a depth of about 1100 feet to 1500 feet. Intermixed with the red beds from about 1500 to 3100 feet are numerous salt and anhydrite stringers varying from a few inches to several feet in thickness. The lower 3000 feet of the Permian system includes the



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Wellington and Pontotoc formations. The former is composed of green shale interbedded with thin layers of anhydrite and dolomite, both of which increase with depth to where they predominate in the lower part of the formation. The Pontotoc includes about 1500-1700 feet of granite wash, interbedded with thin stringers of shaly lime.

The Pennsylvanian system which extends from about 6500 feet to 14,582 feet (deepest that any well has penetrated) is predominately granite wash. The Virgil, Missouri (Hoxbar) and Des Moines (Deese) formations are present.

The granite wash is a coarse Arkosic sand conglomerate, consisting of a poorly sorted matrix of subrounded to angular, medium to coarse quartz and feldspar fragments. Imbedded within this matrix are pebbles of quartz, graywacke and chert which vary in size from a few millimeters up to six inches in diameter. This conglomerate varies widely in its degree of cementation, and in some instances it is loosely consolidated and porous, and in others it is a well cemented mass, with little or no permeability, having an appearance very similar to a piece of rough concrete. Interbedded with the granite wash are marine limestones and sandy shales. The granite wash comprises about 70 to 80 percent of the Pennsylvanian section.

The oil, gas an condensate production comes from a 1700-foot interval between the depths of 8800 feet and 10,500 feet. Seldom is more than 10 percent of the total section sufficiently permeable to be considered productive.

Major Mud Problems

Since the drilling mud bill was extremely high on the discovery well, J. G. Walters 1, considerable thought was given to the planning of more economical mud programs for the subsequent wells. The major problems which were considered when planning the mud program are as follows:

- The major salt section at 1100 to 1500 feet, and the stringers of salt which are present to a depth of about 2800 feet on the east side of the field and 3100 feet on the west side.
- The sections of anhydrite which are found from 1100 feet to 5000 feet.
- Lost circulation zones which are present in an interval from 600 feet to 1250 feet and from 7000 feet to 10,500 feet.

In the early development stages of the field a mud service company placed one of its mobile field mud laboratories in Elk City so that it would be readily available and could help in formulating a mud program for the Elk City field. The laboratory contains all of the necessary equipment for testing drilling muds. Two technicians were assigned to gather mud samples from the different drilling wells and make tests on these samples.

In order to obtain data to use in formulating a better mud program, water meters were placed in the water lines to the mud tanks on two rigs and the amount of water added to the mud system each day was determined. A complete analysis of the mud on the two rigs was made each day; therefore, knowing the amount of water added, the amount of mud in the systems, and the amount of mud jetted away, the amount and kind of contamination entering the system each day could be measured. Also the effectiveness of the different chemicals in combating the contaminants was determined. Much worthwhile information which helped to improve the mud program was obtained by the field mud laboratory on these two wells.

Drilling Mud Program

The drilling mud program at Elk City can be divided into four parts, the conductor hole (0 to 130 feet), the salt string hole (130 to 3000 feet), the interval below the salt string to the top of the producing section (3000 to 8500 feet), and the productive interval (8500 feet to total depth).

1. **The Conductor Hole (0 to 130 feet).** The conductor hole is drilled in sandy red shale, and usually some bentonite is added to the mud in order to raise the viscosity and reduce the thickness of the wall cake.

2. **The Salt String Hole (130 to 3000 feet.** The numerous thick stringers of salt and anhydrite encountered from approximately 1100 to 3100 feet require an intermediate string of casing to be run to a point below the last salt section. This requires setting 2800 feet of casing on the east side of the field and 3100 feet on the west side. If this intermediate string of casing was not run it would be very difficult to maintain a satisfactory mud at a reasonable cost when drilling the pay section owing to the amount of contamination that the salt and anhydrite sections impart to the mud. Recently in order to conserve casing, the salt strings on several of the wells were reduced to approximately 2100 feet. On these wells the cost of the drilling mud was from $4000 to $15,000 more per well. There was also an increase in the amount of lost circulation and hole troubles. Owing to these circumstances the setting of shortened salt strings was discontinued.

At the present time salt clay is the only mud additive used when drilling this section of the hole. In order to determine what type of mud would be best in drilling this section a low water loss starch salt clay mud; a low water loss starch clay saturated salt mud; and a salt clay mud were tested. Similar hole troubles were experienced with each type of mud. However, the salt clay mud was from $1000 to $3000 cheaper than the other types and on this basis it was selected.

The hole is drilled using native mud to a depth above the casing point which will give a mud mixing period of 6 to 8 hours. At this point the addition of salt clay, which requires 3 to 4 hours to yield, is begun and the funnel viscosity is raised to about 50 seconds API. When the casing depth is reached the hole is circulated for about two complete circulations of the system. If when pulling the drill pipe out, tight places are encountered, an additional trip is usually made. When making this additional trip the tight places are reamed out when going in, and after getting back on bot-

About the Author

FRANK S. BELL, Tulsa area mud engineer for Shell Oil Company, received a BS degree in chemical engineering in 1938 and a BS degree in petroleum engineering in 1941 from the University of Oklahoma. During World War II he served in the field artillery. Upon leaving the service in 1946 he joined Mud Control Laboratories, Oklahoma City, and in 1948 went with Shell.

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Complete drilling mud service

underline that word "complete"

tom circulation is continued until the hole cleans up.

The cost of mud on this section of the hole is from about $200 to $500, provided there has been no lost circulation. Occasionally loss of circulation occurs at a depth of from 600 to 1200 feet.

3. Section From Below Salt String Casing to Top of Producing Section (3000 to 8500 feet). After the salt string casing has been set the salty mud in the system is displaced and replaced with fresh water before drilling commences. Steel pits are employed on all rigs as they can be cleaned easier, thereby reducing the salt contamination. Figure 2 shows a typical Elk City drilling rig steel mud pit system. From below the salt string casing to a depth of approximately 6500 feet the drilling mud is so heavily contaminated with salt and anhydrite that the only material added is salt clay. The salt clay is added to raise the viscosity as an increased viscosity will help to keep the hole clean. When the salt content of the mud is below 1 percent and the major anhydrite sections have been drilled the mud is treated with soda ash to remove the calcium. This usually takes place around 6000 to 7000 feet. Following the soda ash treatment bentonite is used in place of the salt clay to give the mud the necessary viscosity. Below 7000 feet there are numerous lost circulation zones. Although it is usually not difficult to regain circulation by the use of lost circulation material, fiber and flake, an appreciable quantity of mud can be pumped into the formation if a careful check is not maintained on the mud level in the mud pits.

Through this section of the hole the funnel viscosity of the mud is usually carried around 32 to 38 seconds API, and the weight is maintained from 9.2 to 9.4 pounds per gallon below 7000 feet.

4. Producing Interval (8500 to Total Depth). At approximately 8500 feet chemical treatment is started and the following mud properties are attained prior to drilling the producing section:

Weight—9.2 to 9.4 lbs. per gal.
Funnel Viscosity—45 to 50 sec. A.P.I.
Water Loss—8 to 10 cc in 30 min.
Gel Strength—0 to 2 gm initial;
10 to 30 gm 10 min.

The chemicals used to maintain these mud properties are soda ash, caustic soda and lignites.

Lost Circulation

The most expensive mud problem at Elk City has been lost circulation. Complete or partial loss of returns has occurred on 80 percent of the wells in the field. On a number of the wells it has occurred while drilling the salt string holes, anywhere from 600 feet to 1300 feet. If only partial returns are lost they can usually be regained by using lost circulation material, cottonseed hulls, mica and wood fiber. If complete or almost complete loss of returns occurs it is usually best to use expanded perlite in gel cement plugs. On a recent well a cement plug containing a mixture of one cubic foot of expanded perlite to one cubic foot of cement, with 10 percent bentonite (10 percent by weight of the cement) was used successfully. The cement plug (100 sacks cement, 25 sacks expanded perlite and 10 sacks bentonite) was spotted opposite the lost circulation zone and drilled out after being allowed to set about eight hours. After drilling out the cement plug there was very little if any measurable loss of mud and cement was circulated to the surface when the salt string casing was cemented.

Below 7000 feet there are numerous lost circulation zones, there being no well defined zone throughout the entire field; however, certain areas of the field have lost circulation zones which are well defined. Lost circulation seems to give the most trouble in the northwest part of the field. In order to prevent loss of circulation mud weights are carried at 9.2 to 9.4 pounds per gallon through the lost circulation zones.

Also, a lost circulation procedure form has been prepared which is placed in each doghouse. The form shows the depths at which loss of circulation can be anticipated in the well being drilled and the depths at which it was lost on offset wells. It shows at which depths the mud should be pretreated with lost circulation material in order to prevent loss of circulation, and also what measures to take to regain returns should loss of circulation occur.

Where only partial returns have been lost they can usually be regained using mica, cellophane, and fibrous materials. Where complete or nearly complete loss of returns occurs fairly good results have been obtained by spotting on bottom 50 to 100 barrels of mud containing the following:

30 lbs. per bbl. expanded perlite
10 lbs. per bbl. fibrous material
5 lbs. per bbl. mica

After spotting the mud containing the lost circulation material opposite the lost circulation zone, which is usually considered to be on bottom, the hole is allowed to sit undisturbed for about an hour. Then if the hole can be filled using the fill-up line the blowout preventers are closed and

• CONTINUED ON PAGE 145

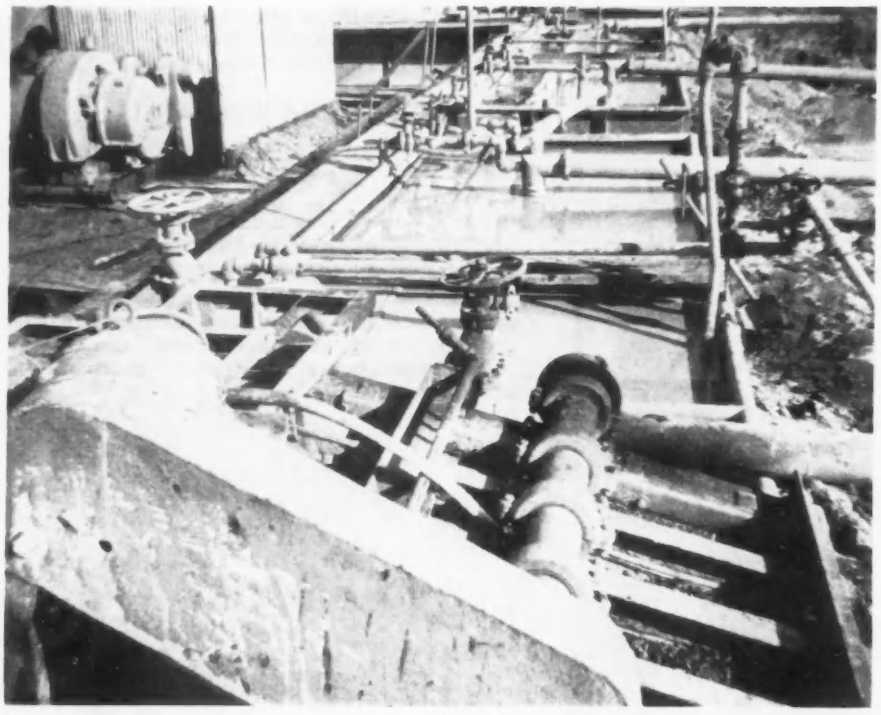
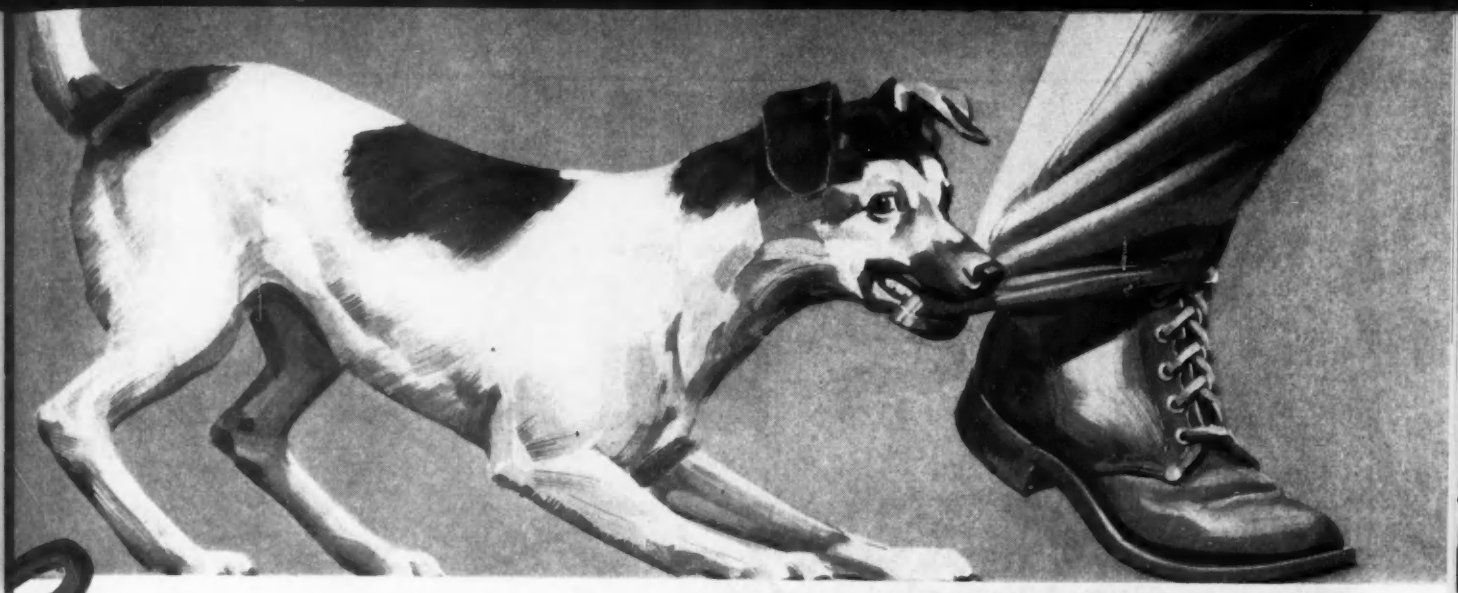


FIGURE 2.
Typical view of mud system layout employed for Elk City drilling. Flexibility permits rapid transfer of mud from tank to reserve system. Mud guns are stationed at points permitting most efficient agitation of drilling fluid.



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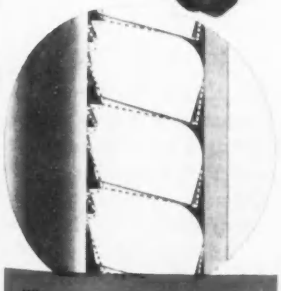
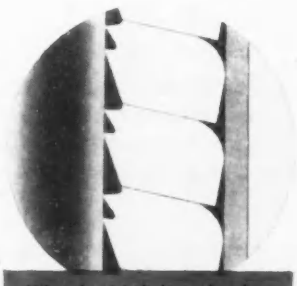


When slips are dropped in bowl, the Dogs roll upward slightly . . . Notice how the Mission tooth design insures positive gripping even after teeth are worn.



When load is being taken by slips, the Dogs roll downward to grip the pipe firmly . . . This positive gripping saves much time usually lost in trying to make ordinary slips hold.

Now slips are supporting pipe: The small, non-continuous dog tooth grip the pipe firmly with minimum damage. These teeth give exceptionally long life.

Now load is being taken off slips: Notice how the dogs roll upward and away from pipe—releasing the pipe and freeing the slips from the bowl.

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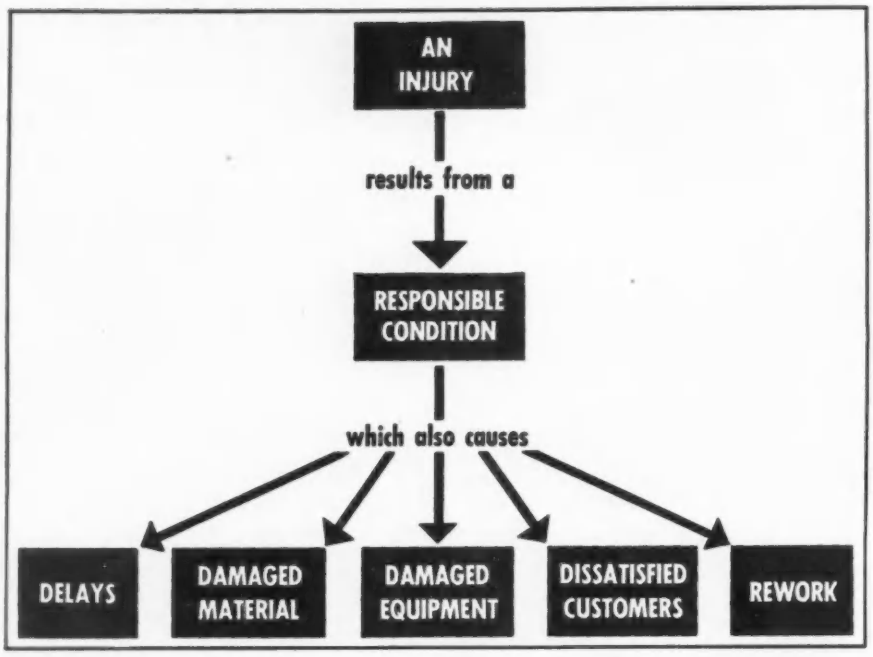

FIGURE 1.
An accident produces a great many results other than personal injuries.

Safety Saves Money

The relationship between injuries and other problems encountered in drilling makes accident control an operating procedure.

By K. R. WELSH, Dallas District Engineer
Hartford Accident and Indemnity Company

THE DRILLING INDUSTRY is interested in safety for reasons humanitarian and economical.

Nearly every company's initial concern with the subject will fall in one of three categories:

- Increased insurance rates. This results from excessive injury cost and because, for the most part, the contractor feels that his interest is a means of satisfying his insurance carrier's concern.
- Humanitarian aspect. The average individual does not like to see or be involved in his fellow man's misery.
- Economy—dual economy. First, the reduction of insurance rates by reducing injury costs; and second, the true economy associated with safety, which is the elimination of waste and damage in all their various forms and not only those associated with physical injury.

Any sound and economical safety program must be built upon certain basic principles:

First, an accident produces a great many results other than personal injury.

Second, the conditions responsible for accidents which result in personal injury are also responsible for many other operating interferences, including other types of accidents.

Many persons would define an accident as an occurrence in which someone is hurt. But there are many accidents in which no one is hurt; for instance, burned-out motors, drill pipe twisted off, fire around the rig, junk in the hole. Far more accidents occur each day in the drilling industry where no one is hurt than where people are injured.

The second principle might involve a skidding motor, winch line parted, motor capsized, crack in the block, and two men injured. Here are operating difficulties and injuries resulting from the same set of conditions.

To apply these two principles to the drilling contracting industry, it is necessary to answer this question: "What does the average contract driller want?" Obviously, he wants to drill the greatest amount of good hole in the least time possible and at minimum cost. If he can do this, he stands better than a fair chance of making a profit. This aim is uppermost in every action of the contractor —the type of equipment he buys, the technique or procedures he uses in drilling, the personnel he employs, the policies he adopts.

And so with safety. A good safety program can help to drill more hole cheaper and faster.

Consider the factors involved in the

Let's Call Wire Rope Constructions

by their Right Names!

This is a message of importance to every user and purchaser of wire rope. It is information that will help eliminate much of the past confusion over wire rope terminology.

How did this confusion arise? Let's illustrate briefly. For years 6 x 19 has been just a name for a variety of six-strand ropes, few of which actually have 19 wires per strand. As an example, our popular 6 x 19 W has always contained 25 wires per strand; the 6 x 19 U, 21 wires per strand. The 6 x 19 Seale, on the other hand, really does have 19 wires in each of its strands. Until recently, the letter or name following the numbers denoted the actual construction; but many users did not know this, and the omission of these symbols occasionally resulted in costly misapplications.

To clarify matters in the various classes of rope, Bethlehem has revised the entire list of misleading designations. For instance, in the Bethlehem terminology, Type W rope is now designated—accurately—as 6 x 25 W (not 6 x 19); Type Q is 6 x 41 Q (not 6 x 37). This completely accurate terminology applies to each and every rope that Bethlehem makes.

Nothing has been changed but the designation. The ropes are made to the same high standards of Bethlehem quality. *Constructions are the same as in the past.* Only the names, the designations, are different. The numbers now mean what they say.

We earnestly solicit your help in publicizing this information. The transition now under way is one that has long been needed.

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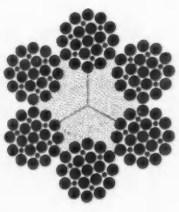
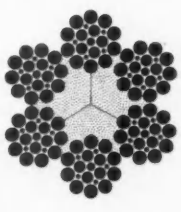
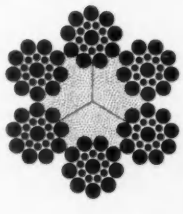
BETHLEHEM STEEL

6 x 25 Type W	6 x 21 Type U	6 x 19 Seale







Of these three ropes, Seale is the only one with 19 wires a strand. Yet for years all three types have been known as 6 x 19. This is not an isolated case. Similar instances occur in other classifications of rope.

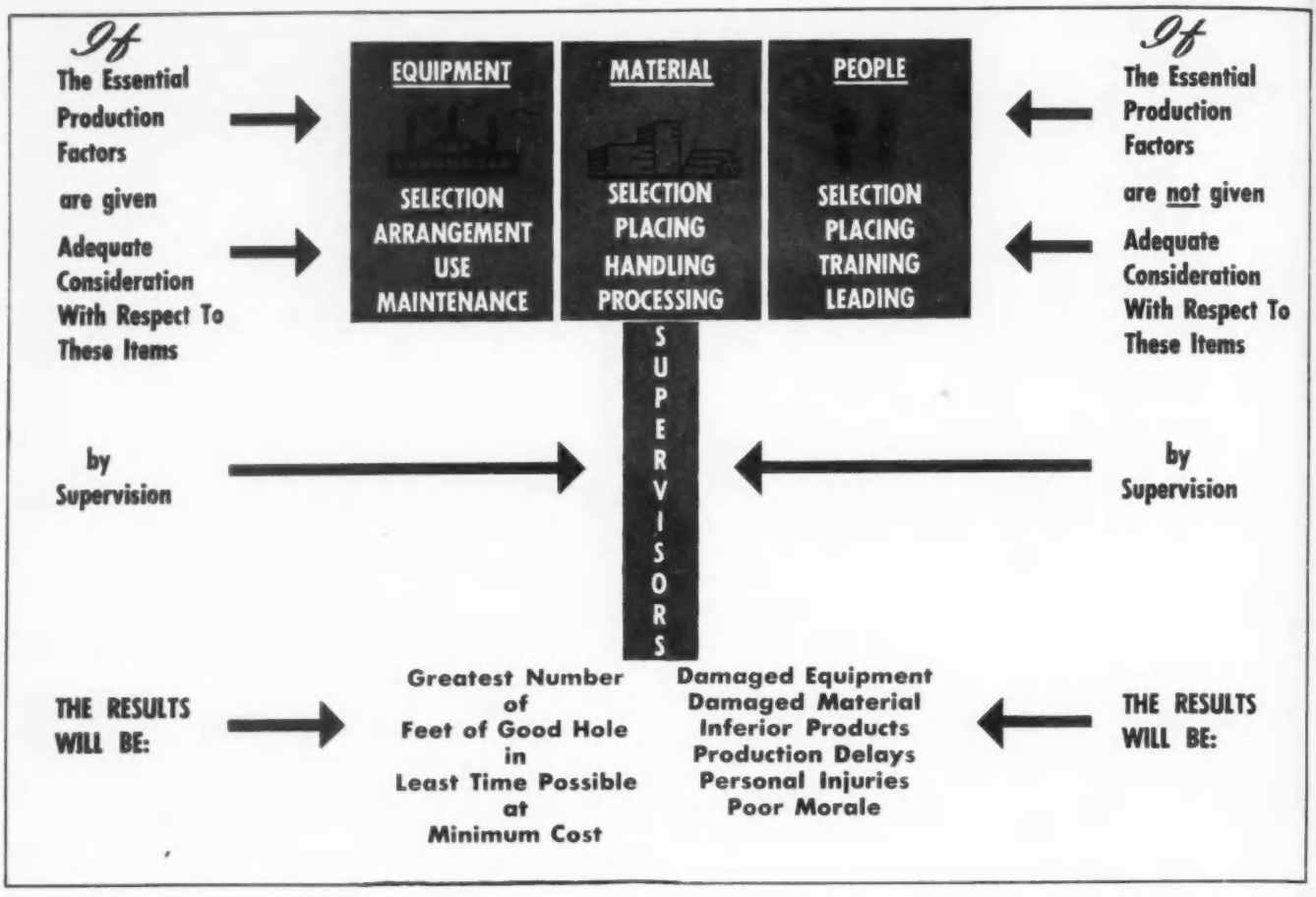


FIGURE 2.
Conditions responsible for accidents which result in personal injury are also responsible for many other operating interferences, including other types of accidents.

drilling industry. Every drilling contractor has Equipment; that is, derricks, drawworks, motors, pumps, trucks and other items of this type.

Every contractor utilizes Materials —such items as lumber, paint, lubricants and casing, all more or less consumable items.

Finally, every contractor needs People—crewmen, drillers, toolpushers, superintendents and executives.

These three factors are just about all the contractor has at his command with which to drill a hole. But mere possession of these factors is not enough. Certain considerations must be applied to each if the contractor is to drill maximum footage in minimum time and at the least cost.

The Equipment factor represents a direct investment that will produce the greatest returns only when proper consideration is given to its selection, arrangement, use and maintenance. The drawworks, for instance, must be designed and selected to handle the required loads adequately and with a minimum amount of non-productive motion and time. It must be so arranged that the drilling operations can be carried on effectively. It must be properly maintained so that down time, due to repairs and breakdowns, will be at a minimum and so there will be a minimum of unnecessary parts replacement or repair expense.

The Materials factor also represents a considerable investment, though it eventually returns in the form of services rendered. The extent to which Materials will produce a profit depends on its selection, placing, handling and use. Lubricants, pipe, tools and mud must be properly selected to give best results. They must be properly placed so as to be available when needed; to occupy the least amount of space; so as not to interfere with operations; so as not to deteriorate because of exposure; and so as not to injure people because of their exposure to them. Materials must be handled correctly so that the amount of handling can be minimized and simplified. The Materials must be used in a manner to avoid waste and so they will become part of the finished product or service.

People, the final factor, represent a tremendous investment, not only in the form of salary, but also in the form of time and money spent on their employment, training and supervision. This investment will pay dividends only if proper consideration is given to their selection, placing, training and leading.

Selection should be exercised with a care consistent with available manpower.

Placing should be in keeping with the best the employe has to offer, taking into consideration his ability, temperament and knowledge.

Training is a constant factor in that people have to be told something when they come to work, even if it's no more than when they should start work, when to quit, and when they get paid. The more information passed along to the new worker, the better job he will do.

Leading is the necessary matter of getting people to do what is necessary, when necessary, and in the manner necessary.

To receive, then, the maximum returns from Equipment, Materials and People, the contractor must give proper consideration to the Selection, Arrangement, Use and Maintenance of Equipment; Selection, Placing, Handling and Use of Materials, and

the Selection, Placing, Training and Leading of People.

These 12 items are the tools the contractor must use to reach his goal of more footage at minimum cost. Their effectiveness depends on WHO uses them and HOW they are used.

The medium of supervision is the answer to "WHO shall use those 12 tools?" It is the duty of the driller, the toolpusher, the district superintendent or the general drilling superintendent to utilize those 12 tools, and they do the job with five tools of their own: Knowledge of Job, Knowledge of Responsibility, Skill in Learning, Skill in Planning and Skill in Instructing.

There are all too many examples of what happens when the supervisory medium does not give proper consideration to one or more of the 12 items for which it is responsible. Consider the common matter of handling lubricants in a 55-gallon drum. There is no rack for the drum, no facilities for extracting the oil other than to tilt the drum. Here is inadequate handling, loss of oil, damage to drum, loss of time, poor employe morale and, again—injuries.

Inadequate consideration by the supervisor of any of the 12 items of production may result in damaged equipment, damaged materials, inferior results, delays, personal injuries, poor morale and a good chance of losing additional contracts (Figure 1). On the other hand, if the essential production factors are given adequate consideration, the results will be more feet of good hole in a shorter time at a satisfactory cost (Figure 2).

In emphasizing here the production aspect of safety or accident control, there is no inference that personal injuries should be de-emphasized. Reduction of injuries is the basic aim, but the fact remains that injuries are but one of the results of inadequate consideration of the 12 production items. To seek the basic cause of any injury is to find one or more of the following involved: the selection, arrangement, use or maintenance of Equipment; the selection, placing, handling or processing of Materials; and the selection, placing, training or leading of People.

An employe's finger has been caught in handling drive chain on the derrick floor. Cause of this accident might have been listed as inattention, the accident typed as "caught between objects." But the safety engineer found that repairs to the unit were made necessary by a lack of lubrication which caused a worn-out bearing. The grease fitting for the bearing was partly concealed and the employe did not even know of its existence. Moreover, the wrong type of lubricant had been used in the first place.

Now consider the conditions really responsible for the injury and the results of those conditions. Arrangement of Equipment: hard-to-get-at and partly concealed grease fitting; Selection of Materials: wrong type of lubricant; Training of People: employe never told of location of fitting.

These are the basic conditions responsible for the injury. The other results: damaged equipment, increased maintenance, loss of time and loss of production.

As a result of this injury, changes were made in operating procedure and the savings effected were many times greater than the total cost of the injury.

Every such case that could be cited would prove that injuries are more significant than the fact that an individual was hurt. An injury is an indicator that something is wrong with one or more of the 12 items accounting for profits and losses. It also indicates the existence of a condition which will continue to be responsible for other losses until corrected.

The relationship between injuries and other problems makes the control of accidents a definite operating procedure.

ACKNOWLEDGMENT

This is from a paper presented at the Seventh Annual Drilling Industry Safety Clinic sponsored by the AAODC in Dallas, May 19-20.

About the Author

K. R. WELSH was a 1929 graduate of Texas A. and M. College. His experience includes industrial sales engineering work, roughnecking for Gulf Oil Corporation, and safety engineering for Hartford Accident and Indemnity Company during the last 18 years. He served in the U. S. Navy during World War II. He is now district engineer for Hartford in the Dallas district.

Planning Mud Program

• CONTINUED FROM PAGE 138

the annulus pressured up to 150 to 200 pounds per square inch.

Some other factors which have been adopted to help prevent loss of circulation are:

- Breaking circulation using reduced pump pressures after getting back on bottom and after any lengthy shutdown period.
- Running drill pipe in hole at reduced speed to prevent excessive pressure surges.
- Reduction of pump pressure when drilling through lost circulation zones.
- When running casing the joints are lowered into the hole slowly to prevent excessive pressure surges.

Although the measures outlined have not eliminated the lost circulation problem they have reduced it a great extent.

Casing Cementing

The salt string casing is cemented using ten percent gel-cement. The gel-cement is mixed at the bulk station and one-half pound of perlite per sack of cement is added if lost circulation has occurred while drilling the salt string hole. The 10 percent gel-cement is used because of cheaper cost per unit volume and lower slurry weight. Better cement jobs have been obtained by reciprocating the casing a few feet up and down when the cement slurry is moving up the annulus.

The production string is cemented using slow-set cement containing 4 percent bentonite and one-half pound of perlite per sack of cement. The centralizer - scratcher - reciprocation method of cementing is used and the primary cement jobs have been nearly 100 percent successful.

Salvaging of Drilling Mud

In 1949 three 500-barrel steel tanks were centrally located in the Elk City field to supply storage room for salvaged drilling mud. To reduce trucking two more tanks were located on the west side of the field in 1951. At the completion of a well the chemically-treated mud is hauled in 30-barrel tank trucks to the mud salvage tanks or to a well where it is to be used. By using this chemically-treated mud to replenish mud systems when lost circulation occurs and in working over wells a profit of $2500 to $5000 each month has been realized.

REFERENCES

1. Wilgus, W. L., "The Elk City Pool," World Oil, June, 1950. Pages 123-126.
2. Goins, W. C., "Pressure Surges and Their Effect on Loss of Circulation," World Oil, June, 1950, Pages 107-112.

How to do it!

DRILLING HINTS

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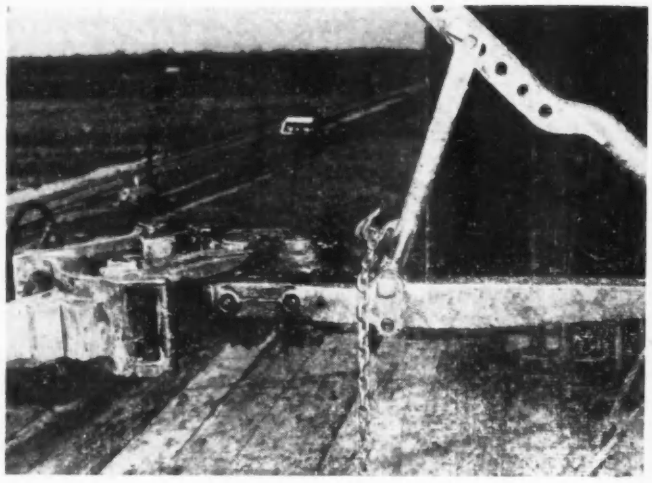
Hook Reduces Chain Hazards

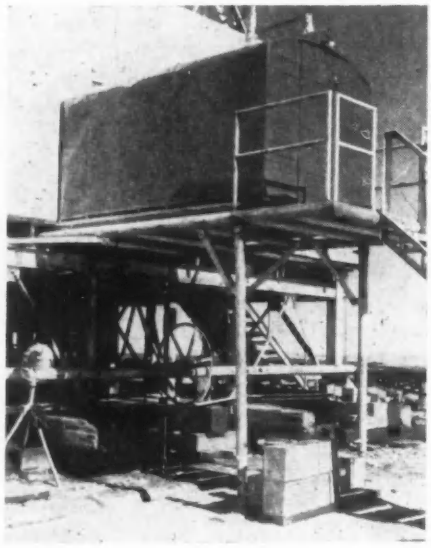


A chain hook on the lead tong vertical support removes the danger of the chain's snapping from a crewman's hand and hitting the driller. A simple, inexpensive installation, it provides an anchoring device for the spinning chain tail. The only provision which must be considered is that the spinning chain is long enough to lock slack after wrapping around the pipe. ping around the pipe.

Aside from this safety feature, fixing the chain in the hook stations it in a handy spot for the crewman operating the lead tongs.

This Iron Stand Protects Swivel

A warehouse platform stand made of scrap iron will provide convenient storage for the swivel when it is not being used. Protected in its own stand the swivel threads will not be damaged by abuse and weather. The stand is made of ¼-inch steel plate and pieces of five- and two-inch pipe. A three foot length of the five-inch material is the main trunk, receiving the swivel when not in use, and serves as the vertical structure. Lengths of two-inch pipe are welded to form braces for the bottom plate which is welded to the main five-inch trunk. Adequate braces are provided by welding four short elements of two-inch pipe at a sufficient angle to offer maximum rigidity. Vertical holes are then bored in each corner of the square bottom member. The stand may be bolted to the floor to give solidity to the structure. Also the bolted base provides a sturdy holder that will stand up under heavy loads and will offer a maximum protection to the resting swivel.



Doghouse Support Is Collapsible

In an area where derricks are skidded from one location to another, instead of being dismantled, the doghouse support is built with a hinged connection to the side sills so it can be folded upward against the structure. The support is built with sturdy pipe side rails, end pieces and the necessary number of cross connecting members. Heavy single pin hinges attached to the ends of the side members and the sill of the derrick form means of permanent connection.

The supporting posts for the outer ends of the side members are also attached with simple single pin hinges, but contain two sway braces, all of which are attached with bolts passing through matching holes in lugs on the posts and on the side members of the doghouse support. When the hole has been completed, the doghouse is moved away as a unit, leaving the supporting structure attached to the derrick. Bolts are removed from the sway braces at the outer end, and the derrick line employed to lift the support against the derrick where it is secured with adequate clamps.

Telescoping legs provide convenience in rough terrain, offering a horizontal support for the doghouse. The steel stairs may be readily fastened or removed from the end support.

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Available with either rock bit pilot or bull nose pilot

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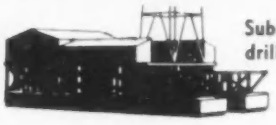
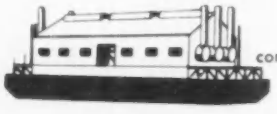


Submersible drilling barges

Tugs



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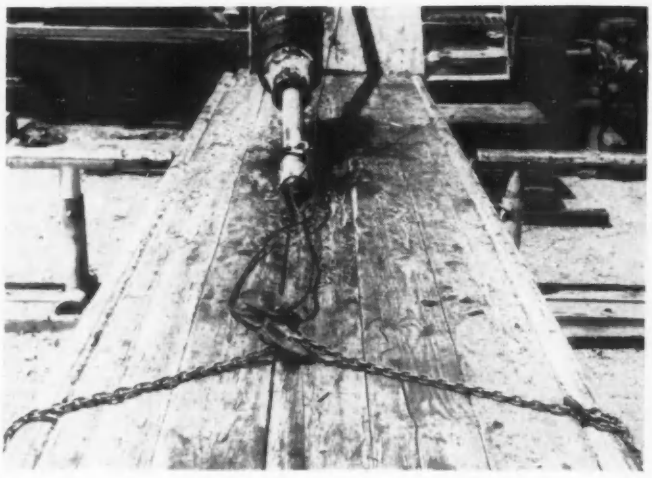
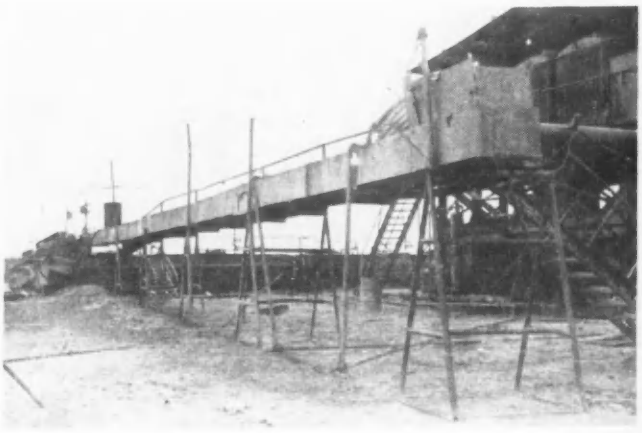
Lifting Packoff Unit Made Easier



By looping a chain around the walkway, attaching a light snatch block threaded with the derrick line, and hooking the line to the base of a single rigged with a heavy packoff unit, the operation of lifting this equipment to the derrick floor becomes much easier.

Once the elevators are engaged and the single is picked up in the derrick, tension is taken on the derrick line to lift the end of the single. In this manner, the end of the single will not drag up the ramp and no damage is done to either the packoff assembly or the pin threads.

Flume Separates Cuttings, Fluid



A long steel flume carried above the ground on fabricated pipe supports can separate heavy cuttings from drilling fluid before the circulation reaches the shale shakers. As the flume creates a gas cut mud, bubbles rise to the surface of the fluid and escape before being held entrained in the suction tanks. Grated walkway on the fume supports give the derrick men access to the area to remove large particles with shovels. Chemical mud conditioners are introduced into the stream at a point several feet upstream from the shakers so that an adequate blend or mixture can be obtained without agitation.

Handy Rack Holds Hand Tools

Hand tools in current use daily on the floor of a rig are stored temporarily on a simple hanger made of three pieces of two inch pipe and a screwed fitting to form a letter "T." The hanger is set on the floor of the derrick in the spot most accessible to the crew, so that the fewest steps must be taken to obtain the required wrench, hammer or hack saw. Individual hangers for box end wrenches, pipe wrenches and the like, which may

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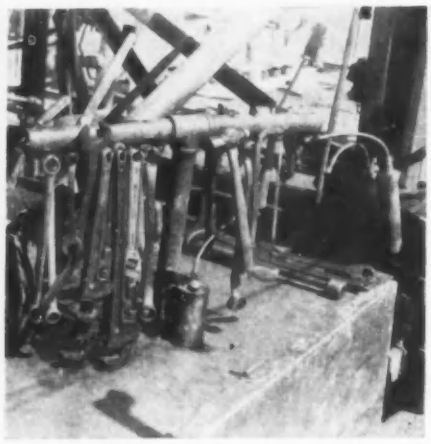

be placed on the stand, are shaped pieces of light rod, similar to heavy uncoated welding rod.

The hangers are spaced at desired distances from each other, and are attached to the lower side of the arms of the "T" by welding. So that a greater number of tools can be placed on the hanger, both sides of the "T" arms are utilized to the fullest extent. A two-inch collar attached to the floor of the derrick supplies means of setting the tool hanger, which contains a threaded end on the lower part of the vertical member of the "T."

Discarded Panel Used as Vise Base

In a maintenance shop where small parts are repaired, a side panel of an old and discarded cast iron heat exchanger has been adapted for the base of the vise. A six-inch-pipe post set into the ground outside the maintenance building supports the base, which is installed concave side up. The large number of bolt holes around the sides provide means of attaching a vise and tail support in any one of many different positions. As the cast iron part is similar to a shallow trough, it also serves as a receptacle for tools and parts used by the maintenance mechanic. It is sturdy and makes an excellent outdoor work table.

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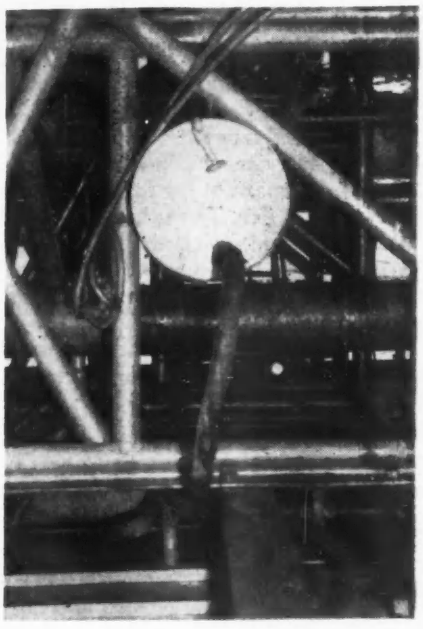
Davit Crane Lifts Pump Suction Hose

To lift the suction hose on a mud pump, one contractor installed a davit type crane to the frame of the pump. This crane is made of pipe with two

standards, a cross member and a supporting truss, all welded into a single unit. It is mounted on two stub posts welded to the frame, or skid member of the pump, so that the two posts can be set easily in place. Locking pins, made of rods, slips through matching holes in both the supporting posts and the stubs upon which they set. A ring at the outer end of the cross member serves as a hitch for a chain hoist, or a simple set of blocks. This device is used principally for foot valve and strainer inspection or repair when debris may clog the inlet bars of the foot valve.



Oil Drained Into Convenient Drum

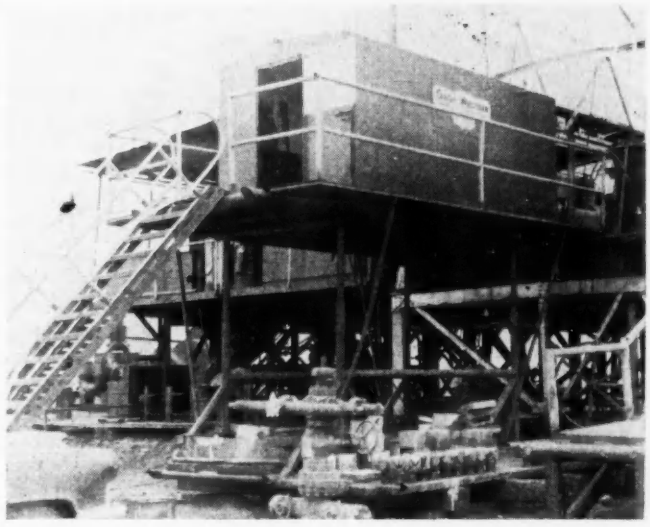
Oil drained from the engine crankcases serves many useful purposes around a drilling rig. Generally, the drain oil is saved for oiling chains, etc.

For the sake of convenience and to reduce the possibility of drain oil becoming contaminated with sand or water, one operator placed a drum within the substructure and connected a hose to each of the engine drains. Draining oil from the engines merely involves opening a valve to deliver oil to the drum for storage.

A valve makes it easy to tap the drum for oil. The idea is inexpensive and will protect the drain oil from contamination. At the same time the drum is in a convenient spot and the job of draining oil from the engine crankcases can be done by one man in just a few minutes.

Catwalks Relieve Doghouse Traffic

Dog houses are commonly set on supporting posts at the side of the derrick with a stairway leading to the outer door. Ordinarily, men must pass through the building from the ground to the floor, but one contractor has added cat walks provided with safety rails on both sides of the building so that men need not disturb occupants when making a hurried trip. The cat walks are integral with the building and are attached to the dog house with the cross sills forming the floor of the building itself. Diagonal supports from the bottom rail of the substructure are set in ferrules on the outer rail of the catwalks to support the weight of men walking along the path.



Doghouse Built Over Change House

Instead of building a skeleton frame as support for the rig doghouse, why not use the top of the change house? In the pictured installation the change house rests on fabricated substructure to bring the entire set of units to the desired height to fit the substructure of the drilling rig. The twin buildings are constructed of steel and each is supplied with heating stoves during cold weather.

The top rail of the change house

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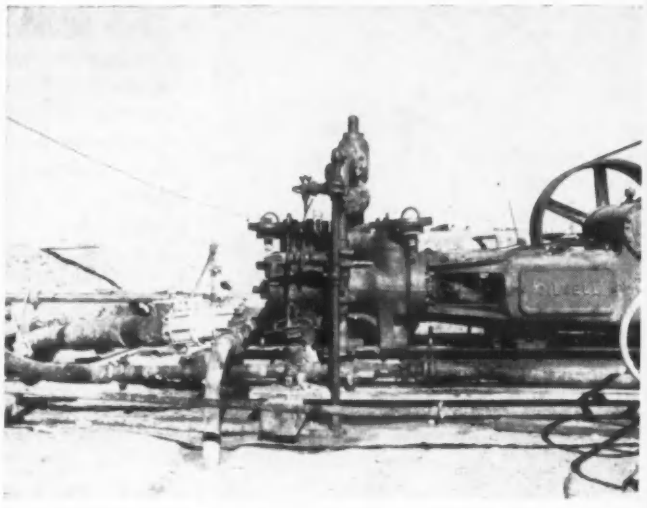
Pumps Use Same Discharge Line



was built to receive the upper end of the doghouse stairway which hooks over the pipe rail. The change room entrance is provided with a short step-ladder for easy access. The doghouse itself is provided with doors at each end and may be entered from the stairway or from the derrick floor. This arrangement places the change room as near the derrick floor as practicable, and workmen can eat lunch as near their work as possible, ready for any emergency.

In order to minimize the number of fittings which may be required to connect discharge from two separate pumps, a combination manifold has been developed by a contractor in New Mexico. The manifold is attached to the principal pump, driven by the drilling engines, and consists principally of a threaded tee. The tee runs so that the side outlet serves the principal pump, while the fluid from the second unit passes into one end and mixes with the mud from the first so that all mud passes to the derrick standpipe through a single line. This manifold lays snugly against the footing of the principal pump and is transported from one hole to another without the necessity of disconnecting. The manifold contains two gate valves, one between the discharge of the pump upon which the manifold is attached and the running Tee. The other is between the second pump and the manifold so that either pump may be shut down for repair without disturbing the operation of the other unit. This offers great flexibility and makes the compounding a rather simple operation.

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Subsurface Pressures Tell Story

Recorded pressure charts will reveal more than meets the eye. Proper interpretation shows not only reservoir data but success or failure of test.

By C. C. OLSON
Halliburton Oil Well Cementing Company, Duncan, Okla.

WHAT ABOUT DRILL stem testing? How do you know when results are valid? Increasing importance of drill stem testing makes it necessary to know what goes on during these operations. Application of bourdon tube pressure recorders to drill stem testing equipment makes it possible to obtain an accurate pressure picture during these tests. Knowing what these records mean will enable the operator to better evaluate drill stem testing so that good tests can be made and corrective measures taken to insure a quality test.

A steadily increasing interest in the evaluation of drill stem testing pressure charts has become prevalent throughout the industry. Proper interpretation of these data is highly important to the best use of drill stem testing. It should be understood that careful consideration must be given to all factors involved in the planning of the test in order to obtain desired results. Among items to be considered are:

- Removal of tight spots in the hole.
- Removal of all drilled cuttings and/or cavings from the hole.
- Proper conditioning of drilling fluid for the testing operation.
- Careful selection of the proposed packer seat.
- Clear-cut instructions to the testing crew so they may supply the correct tool assemblies and necessary instruments to obtain the most accurate record possible of the entire test.

Much can be learned by a careful study of previous tests which indicate significant conditions that prevailed during the test. The charts shown here were recorded by the bourdon tube pressure recording device which is a large size of the parallel design to the Amerada RPG-3 instrument. Charts are read with a micrometer chart reader with an error of plus or minus 1/1000th of an inch. Deflection readings are then converted to pressure from individual calibration curves which are drawn on 10 x 10 cross-section paper, the vertical scale having a value of .100-inch per inch and the horizontal scale equal to 100 pounds per square inch per inch. With this reading technique extreme accuracy is obtained.

Charts illustrated are actual authentic original recordings from various drill stem tests, the only exception being the symbols used to designate certain points of discussion. Accuracy of the recording gage is maintained by re-calibration on a 60-day interval using a dead weight tester with a maximum error of .1 of 1 percent based on a "G" factor of 980.076 centimeters per second squared at an operating temperature of 68 degrees Fahrenheit $\pm$ 10°. Instruments are calibrated at three previously selected temperatures in an oil bath with temperature control of $\pm$ 2° F.

Figure 1 (Chart 40213) is shown primarily to discuss and clarify all recordings. The straight line at the top of the chart extending from "a" to "b" is the base line drawn on the chart inside the instrument under atmospheric pressure only. This line is drawn by allowing the chart drum to travel downward in its normal operating plane and with the gage standing vertical, thus eliminating any possible error of static friction. The time scale on this type chart is from left to right horizontally and is relative to the rated speed of the clock being used which would be either 12, 24, 48 or 72-hour duration. When pressure is applied the stylus will move away from the base line in a vertical plane downward.

Slope of all recorded lines is pressure vs. time, for example, "A" to "B." This is the increasing weight of the column of drilling fluid vs. the elapse of time while lowering the tools in the well. "B" to "C" is the pressure recorded while the tools were allowed to hang stationary in the hole at the depth desired to set the packer and this reading is known as the "initial hydrostatic mud weight." This period of delay should always be taken in order to obtain a clear recording of the hydrostatic weight of the drilling fluid.

The packer is now set and testing tool opened. "C" to "D" is the recording made at opening of the testing tool and denotes a decreasing pressure from the hydrostatic to the point where the formation pressure, if any, assumes control. This point is read and known as the "initial flow pressure." At point "E" the tool is closed and this point is read as "final flow pressure." The line "E" to "F" is the reservoir pressure built up when the tool is closed and is referred to as the "closed in pressure" at point "F." The line "F" to "G" is the pressure increase obtained by opening the bypass and allowing the hydrostatic mud weight to be again applied to the formation and equalize across the packer. The reading at "G" is known as the "final hydrostatic mud weight." "G" to "H" is the record of the decreasing pressure vs. time as the tools are pulled from the well bore. At point "H" the pressure has returned to zero. The horizontal lines marked with the letter "Y" each have a value of 1000 psi cumulative from the zero pressure base line. These are scribed onto the chart with the chart reading

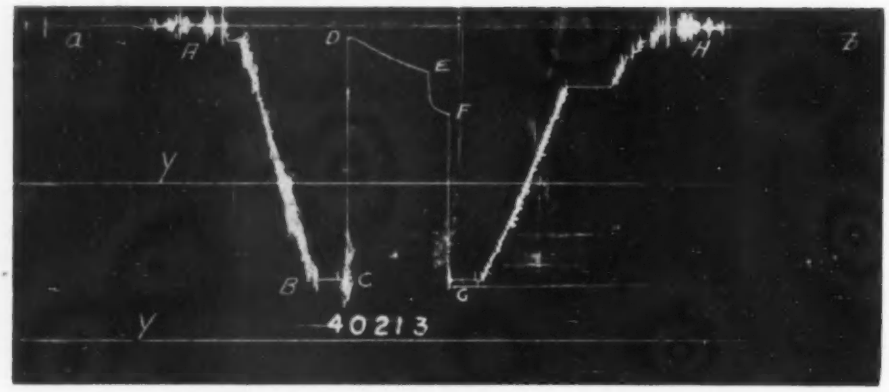

FIGURE 1.
Chart 40213 demonstrates important points on pressure charts.

FIGURE 2.
Drill pipe leak is evidenced by loss of pressure at points circled.

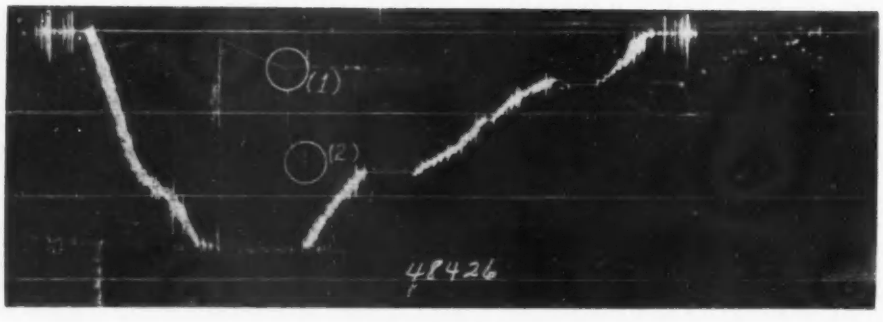

FIGURE 3.
Final flow pressure, Point 1, and closed-in bottom-hole pressure, Point 2.

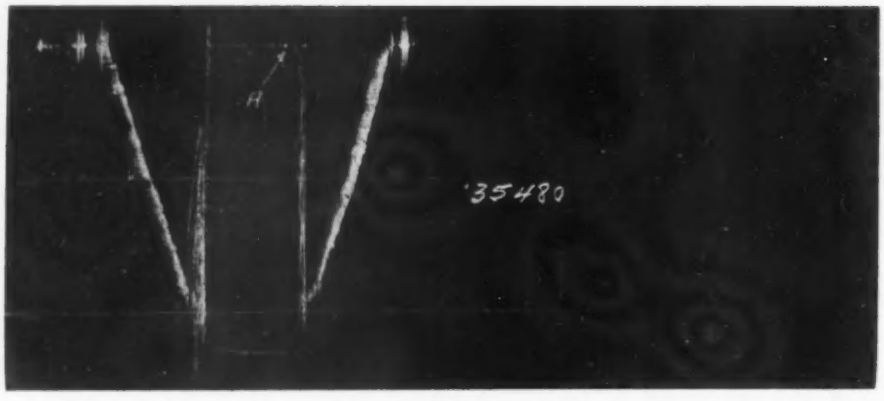

FIGURE 4.
Pressure chart of test on a "dry" formation.

instrument. The number 40213 is the testing ticket number covering this test. As noted above, five readings were made on this chart and these readings were corrected for the temperature of the well in which the test was made. This temperature correction was also applied to the 1000 psi horizontally scribed pressure lines.

On Figure 2 (chart 20913) three points have been circled and by comparison of these points it can be established that the drill pipe was leaking on this test. The recording made in circle (1) indicates that the tools were lowered a short distance into the hole and four periods of delay were recorded before everything was in readiness to proceed steadily with the running of the testing tools. During these delays it will be noted that the horizontal lines recorded run parallel to the base line indicating that there was no loss of drilling fluid to a thief formation. Delays recorded in circles (2) and (3) show a definite decreasing pressure indicating a loss in the hydrostatic mud weight. Since this was not indicated in circle (1) we would therefore check our recovery for abnormal mud recovery. On this test the recovery was 2950 feet of salt water and 500 feet of mud. This amount of mud recovered plus the other evidence establishes as a fact drill pipe leakage. If the mud recovery had been normal, 10 to 50 feet, this would have then indicated that some formation had broken down due to running the tester and was taking the drilling fluid.

The initial hydrostatic mud weight can be roughly checked by mathematical calculation as follows: Multiply the packer depth in feet times the weight of the mud in pounds per gallon times the factor .052 and the answer will be the head of mud in pounds per square inch. Example: 5285′ x 10.2# x .052 = 2803 psi.

The initial flow reading is relative to a number of things, only one of which is definite. In the event a water cushion is being used, the initial flow reading cannot be less than the weight of the head of the preloaded cushion. Other than this the decreasing pressure may halt at any point below the static formation pressure that the formation starts to deliver. There is no positive means of checking this point by mathematics.

Figure 3 (chart 48426) illustrates the final flow reading which is shown by circle (1), this being the point where the testing tool was closed. This point can be checked by the mathematical calculation of the head in psi of the weight of the fluid recovered, if

and when the well does not flow. If the well flows and is not restricted by a subsurface choke of a diameter smaller than the surface choke, this point can also be closely checked by calculation of the gradient weight of the flowing column plus the surface indicated back pressure created by the surface choke. In the event the formation has a high productivity index and the recorders are run below a bottom-hole choke, the recovery plus the surface back pressure will not always check with the subsurface recorded flowing pressure since additional back pressure is being maintained by this reduced bottom choke.

Point 2 is the recorded closed-in bottom-hole pressure buildup. This occurs after closing the testing tool valves and before opening of the by-pass. Before a closed-in pressure reading is accepted as reliable, a close study of the entire test should be made. With the exception of a few isolated zones in certain areas, it is necessary to obtain formation delivery, oil, gas or water, before a true closed in pressure can be obtained. On the test shown by Figure 3, the recovery was 1185 feet of oil and the fillup rate while the tool was open indicated a good pi. Character of the buildup curve toward the end of the time period would make it acceptable as accurate.

Figure 4 (chart 35480) shows a test which had a total recovery of 3 feet of mud, no oil, gas or water. This chart clearly shows at "A" the point where the tool was closed but since the formation was dry there was no buildup pressure.

Figure 5 (chart 5207) shows a test with no formation recovery yet a closed in pressure was recorded. This buildup curve displays an "S" type curve or a recorded buildup which starts off slow then increases its rate, then starts slowing down due to the pressure head being built up.

This type curve is a clear indication of vertical porosity, cracks or crevices in the formation which allows seep leakage through the formation around the packer. Even though this allows only a small amount of fluid transfer from above the packer to the area below, it is sufficient to create the false buildup pressure recorded.

A water cushion was used in the test represented by Figure 6 (chart 48564) as indicated by the two stops while going in the hole. These stops are equal to the hydrostatic weight of the drilling fluid at those points and not

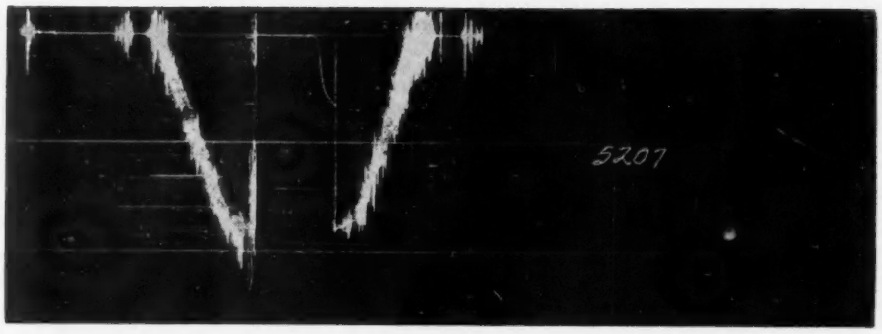

FIGURE 5.
No formation fluids were recovered on this test, yet a closed-in pressure was recorded. This is indicative of seepage through the formation around the packer.

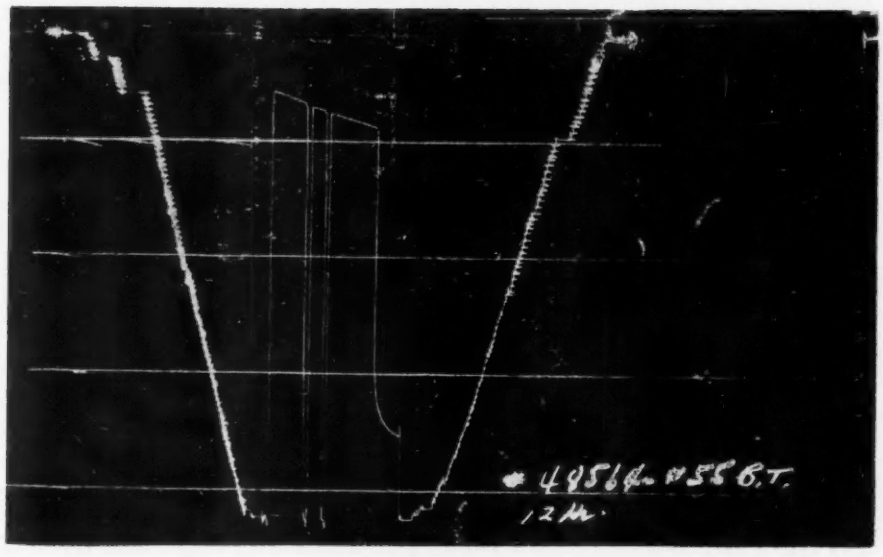

FIGURE 6.
Example of a chart produced when a water cushion is used.

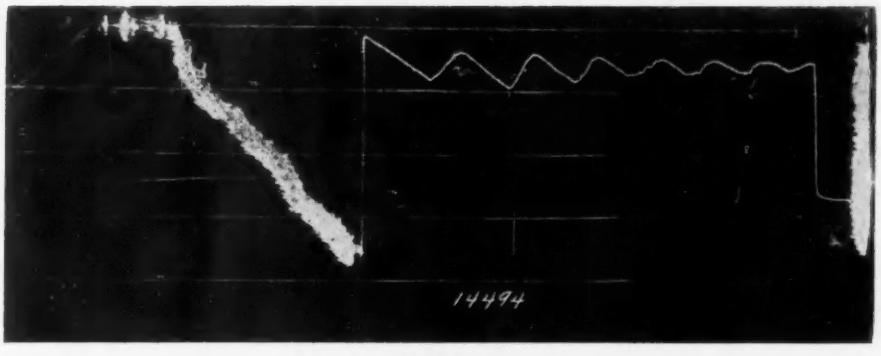

FIGURE 7.
This well flowed by heads with gas pockets between oil flows.

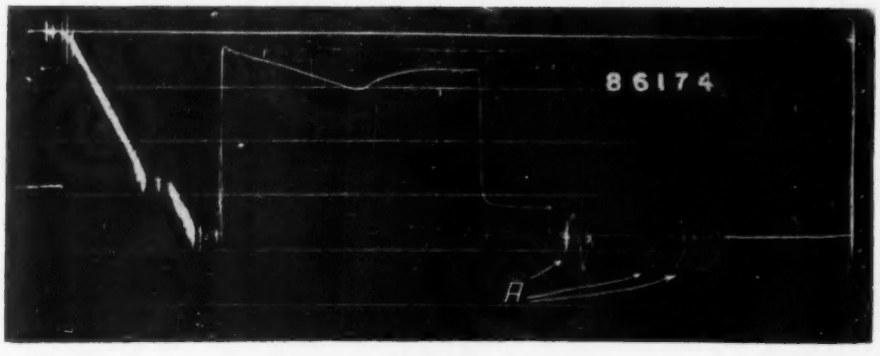

FIGURE 8.
Sufficient data are found on this chart to permit a productivity index calculation.

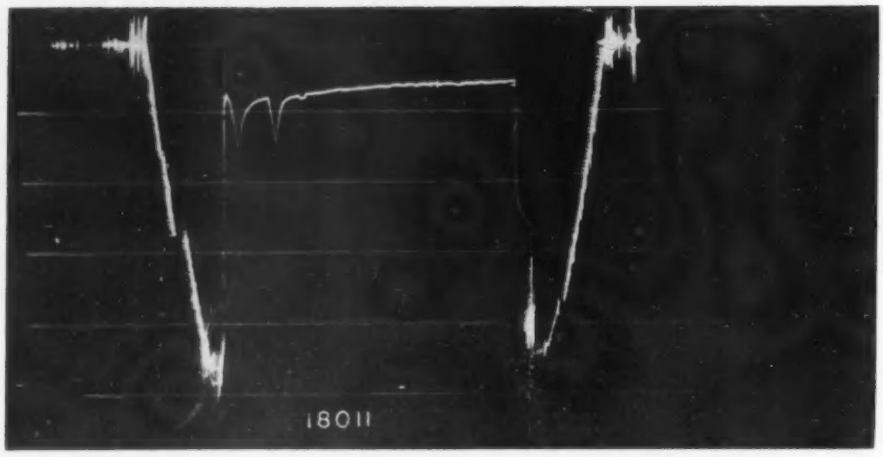

FIGURE 9.
Test tool here was opened against a closed control head with no water cushion used. Gradual decline of pressure indicates low porosity and permeability.

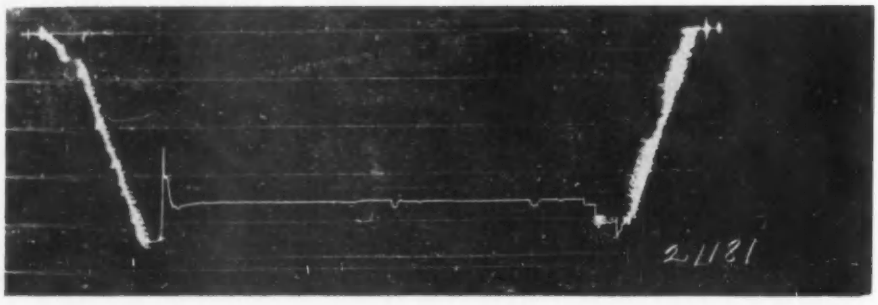

FIGURE 10.
A very stable flowing pressure is indicated in this test. Bumps in curve were made when control head was closed for short periods.

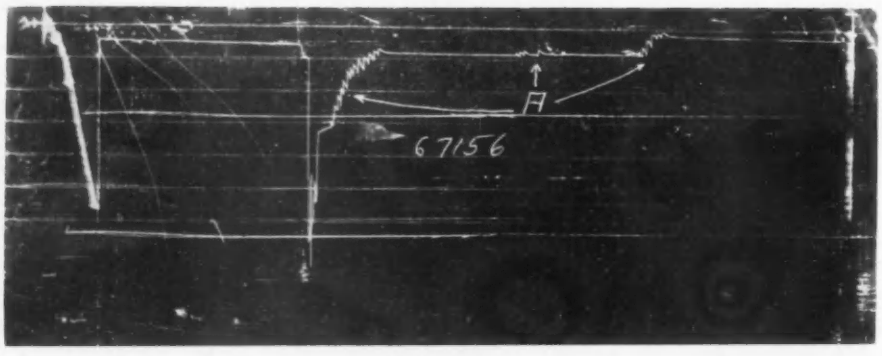

FIGURE 11.
Chart made when well was acidized and swabbed during test, with no apparent help to formation's productivity.

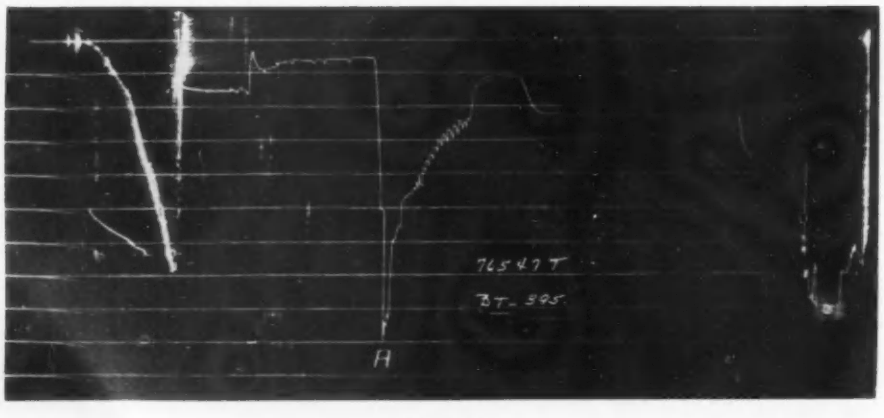

FIGURE 12.
Acidizing during this test and subsequent swabbing made a big difference in this well as indicated by increase in subsurface flowing pressure.

the weight of the water being used as a cushion. When the tool was opened the initial flow could not be less than the weight of the water which was placed inside the testing string; therefore, the formation is preloaded with this amount of back pressure.

Water cushion is used primarily for two reasons:

- When high pressure with high productivity is expected the cushion will slow down the initial rate of flow relative to the amount of load used. In doing this it also decreases the possibility of pulling in the formation due to the sudden drop in pressure in the well bore.

- Water cushion is also used to prevent collapsing of the testing string in very deep wells or where the mud weight is extremely heavy. Tests have been run where too much load was used and after the tool was opened the water cushion was lost to formation down to the static pressure of the zone plus a few pounds created by friction, and then for the remainder of the test the pressure would remain stable. No formation production would be obtained as the load created by the water was equal to the formation pressure.

Further observation of this chart reveals that even though fluid entered the testing string throughout the test, the tool valves were closed and the bypass was opened to flush the testing string with the idea that the anchor perforations could have been partially plugged. This, however, was not the case as fluid entry was steady after each tool opening.

Charts obtained on tests where the well flows have no set or established pattern. Two examples have been chosen where the flow consisted of oil and gas and two more where the flow was gas with a small distillate content. The first chart, Figure 7 (chart 14494), illustrates a well flowing by heads with gas separation or gas pockets between the oil heads. When the tool was opened the formation started to deliver fluid and the column increased until it reached the surface where it started to unload thus accounting for the decrease in the weight of the column. Gas blew down and the indicated pressure shows that a new head is being pushed up the test string. Note that the pressure differential of each cycle continues to grow less. If the test had continued for a longer period the well might have flowed at a steady rate equal to the productivity of the zone, as the closed-in pressure indicates suffi-

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- Unit is integral and requires no outside connections other than fuel lines.
- Base tripod is wider and higher, allowing a higher break out point and ample room for servicing well-head.
- Scavenger tank is integral with main base and has been appreciably increased in volume for storage capacity.
- Main control valve is actuated hydraulically through a centrally located control panel.
- "O" ring seals are used extensively to replace gaskets thereby assuring drip-proof joints in cylinder sections, etc.
- Where possible, welded and flanged pipe connections have replaced threaded joints in pressure lines.
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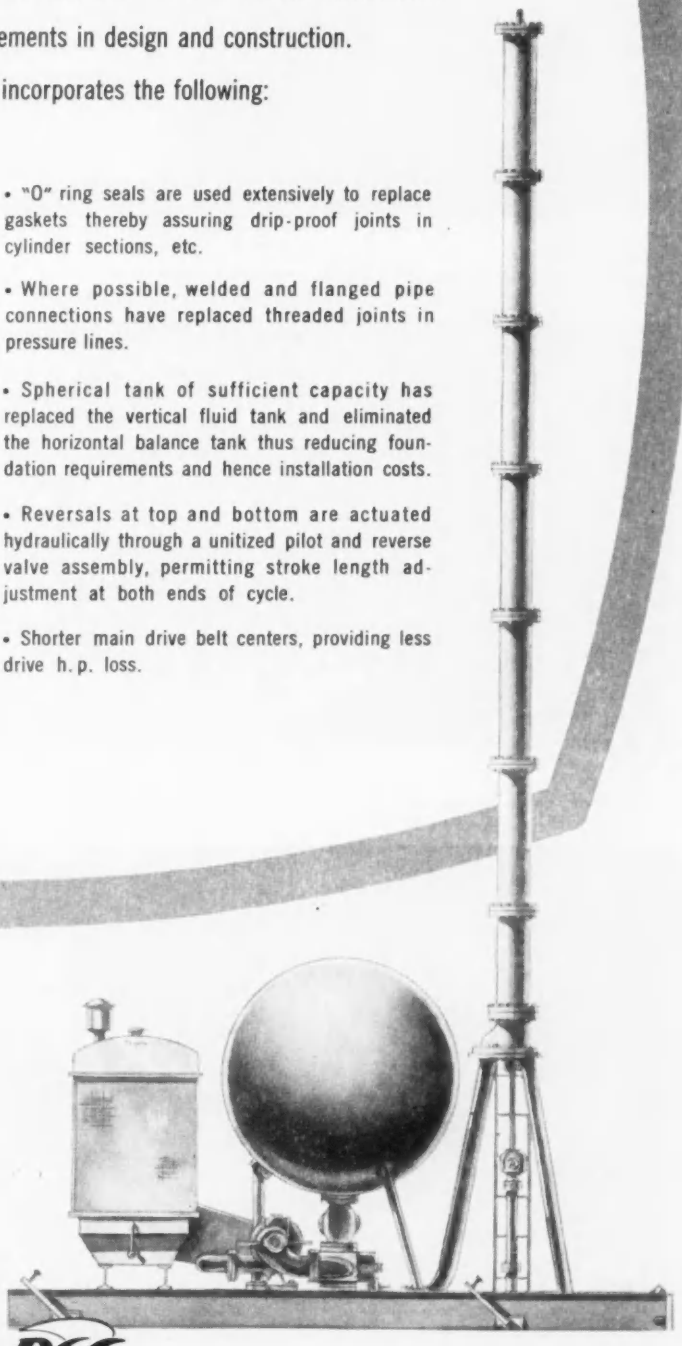

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cient formation pressure to maintain steady flow.

Figure 8 (chart 86174) could be used to calculate a pi for the zone being tested. A steady rate of flow after the initial fluid was unloaded is indicated. Also, the well was gaged into a stock tank with a rate of 17 barrels per hour. A reliable closed-in pressure was obtained which had almost reached a static condition and was read at 3229 psi. The final flow pressure was read as being 665 psi. This would equal a pressure drop of 2564 psi. Therefore, if we take 17 barrels stock tank oil times 24 hours, it will give a daily production rate of 408 barrels. By dividing the 408 barrels by 2564 psi the pi would be .198 barrels/pound pressure drop. It will also be noted that after unseating the packer the oil remaining in the test string was reversed out, shown at "A," as a safety measure to prevent possible fire and this also allows the drilling crew to pull dry pipe coming out of the hole.

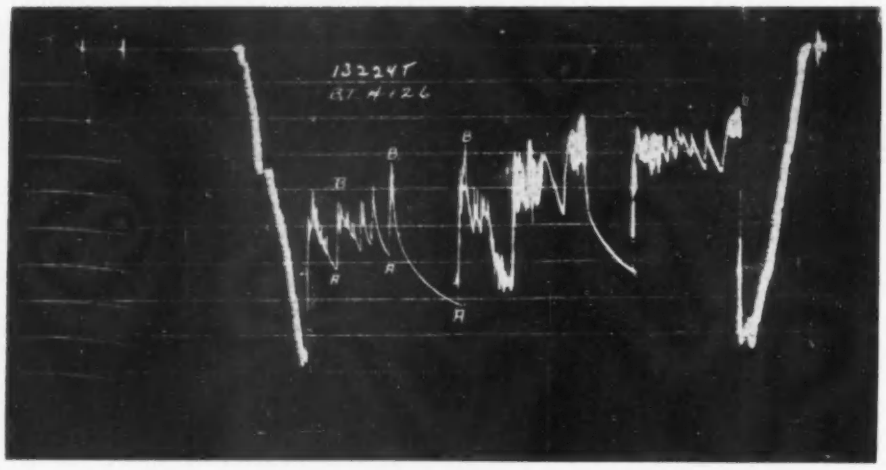


FIGURE 13.
Bottom-hole choke was plugged with lost circulation material in this test. Value of this test was nil.

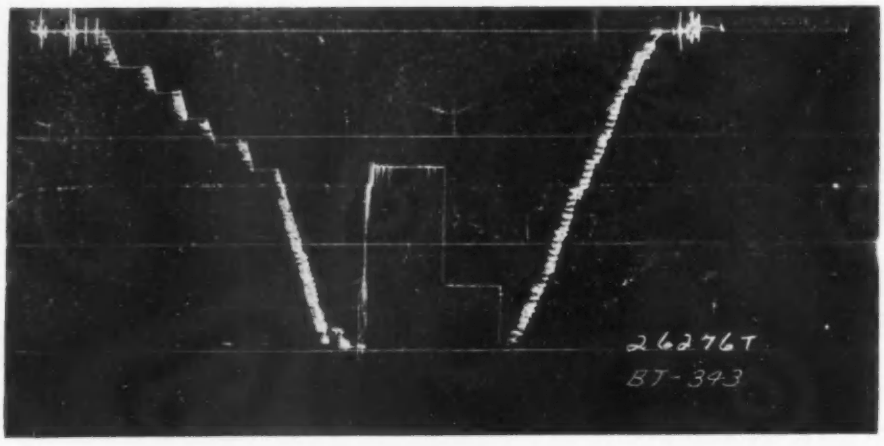


FIGURE 14A
Chart taken by top recorder located inside test string where two recorders are used.

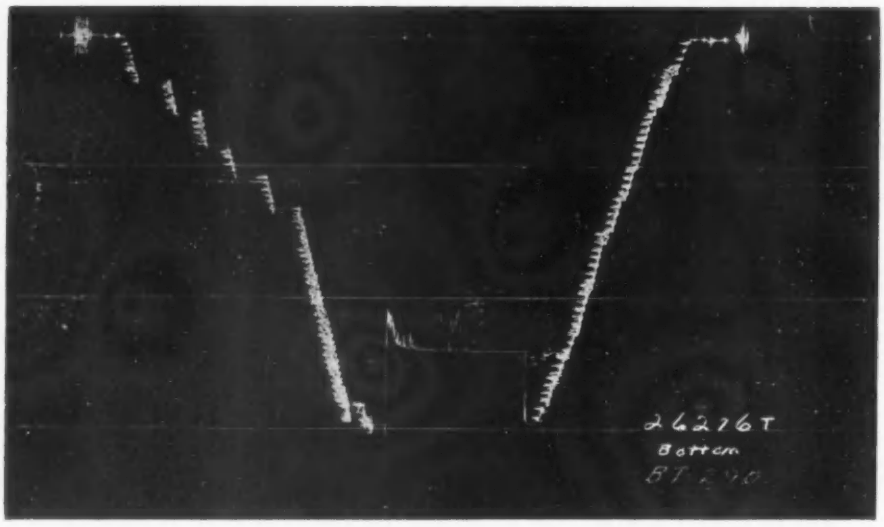


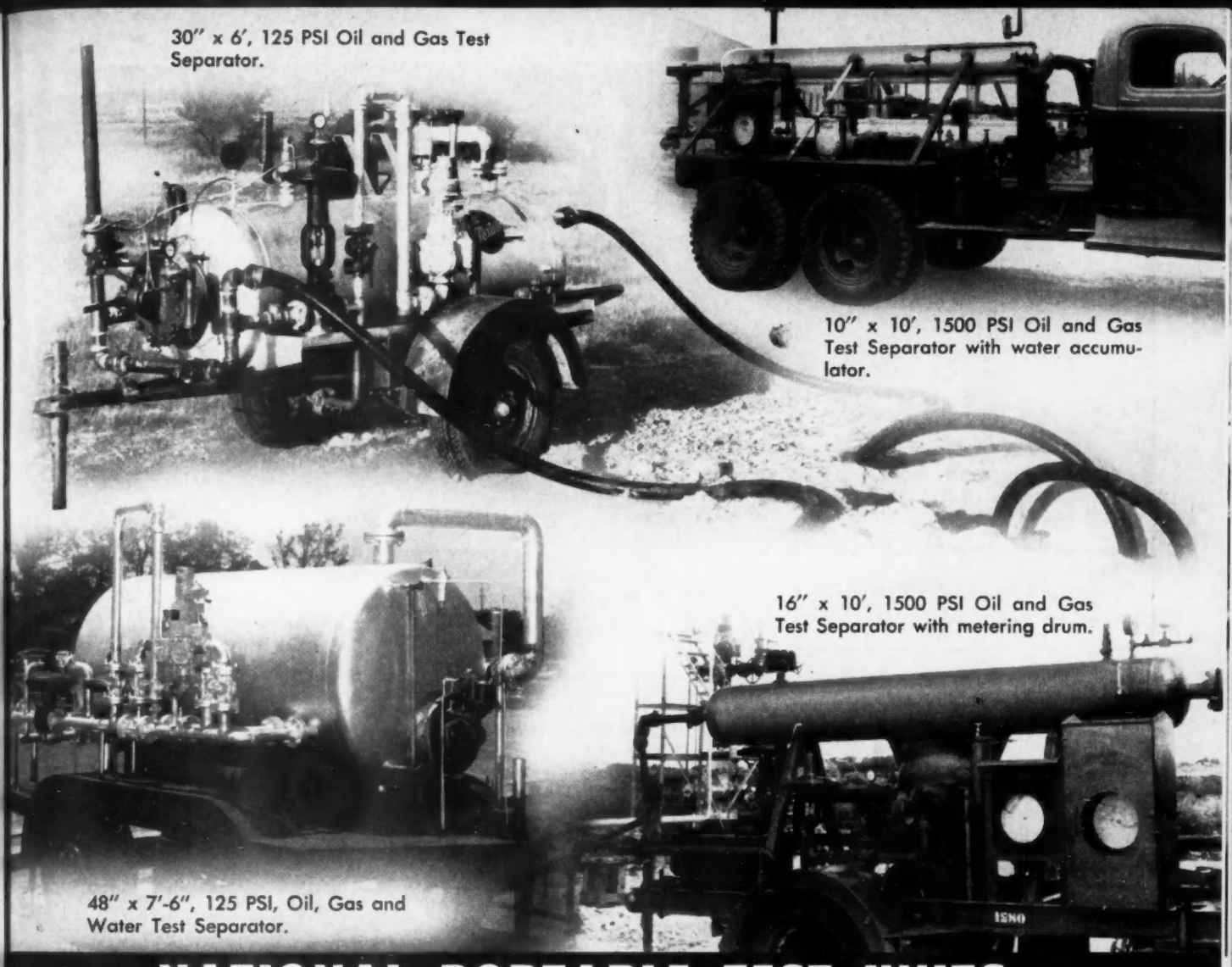
FIGURE 14B
Bottom recorder located below formation packer in dual pressure recording of drill stem tests.

On Chart 18011 (Figure 9) the test tool was opened against a closed control head with no water cushion being used. This rapid buildup indicated was stopped when surface connections were made and the control head valve was opened; next, a second shutin at the control head was made. The well was then opened to the air and gaged at 2 million cubic feet per day. The wide flowing line is caused by small heads of distillate being produced with the gas. Flowing pressure steadily decreased throughout the test, indicating a very low stable rate of daily production even though it has a high closed-in pressure. This indicates low porosity and permeability and probably short life as a commercial producer.

Figure 10 (Chart 21181) is the reverse of the condition of Figure 9. The tool was opened with 1000 feet of water cushion and unloaded this cushion in a matter of a very few minutes showing only a slight decrease in flowing pressure at that time. It then maintains a very steady flowing rate throughout the test. It is interesting to observe the two periods when the control head valve was closed, one being about midway of the flowing period and the other near the end. Note the closed-in pressure at the end of the flow period and that all three points are equal in pressure value. Surface flowing pressure was 3000 psi, the subsurface flowing pressure on ⅛-inch choke was 3610 psi and the closed-in pressure was 3735 psi. Therefore, a well of very high productivity is indicated with only a subsurface pressure drop of 125 psi on ⅛-inch choke.

In some areas it is common practice to test, acidize, swab out the acid load and re-test. Chart 67156 (Figure 11) was made on a test of this kind. The tool was opened and during the entire testing period no entry of fluid was indicated as no surface blow was observed. Acid trucks were called, connections made and acid pumped into the test string. Indicated subsurface formation-breakdown pressure was a little over 7000 psi. As soon as the acid was displaced, swabbing tools were assembled and the acid load was swabbed out. Each run of the swab is

• CONTINUED ON PAGE 171



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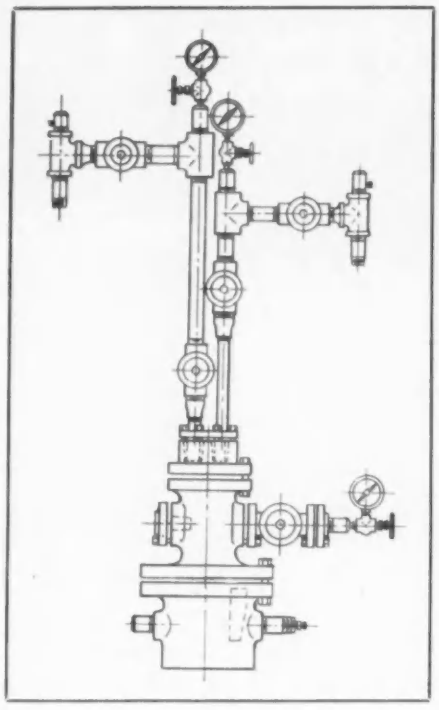


FIGURE 1.
Drawing of christmas tree for dual completion using two full size tubing strings.

Shop photograph of completed tree for dual completion. Screw-type fittings will be replaced by flange fittings on all subsequent wells that are completed dually.

Dual Completion Takes Two Full Size Tubing Strings

Here's how the problem was solved, design of equipment used and installation procedures.

By ROYAL W. REISS, Superintendent,
Alcoa Mining Company, Port Lavaca, Texas
and **J. E. KASTROP,** WORLD OIL Staff

TWO STRINGS OF two-inch tubing were run side-by-side to make a successful dual completion of a gas well. The operation was carried out by Alcoa Mining Company in its State Tract 185, Well 2, in the Steamboat Pass field off the coast of Calhoun County, Texas. Located between the mainland and Matagorda Island, this gas field contains several commercial producing horizons that supply gas to the Aluminum Company of America's new Point Comfort plant a few miles away at Port Lavaca, Texas. There are five gas wells in the field at this writing. Three wells are dual completions and two are single completions.

Dual completion of wells in multi-sand fields over a period of years has proven both economical and practical. In most cases, these installations consist of side door chokes, cross-over packers and related equipment. Flow has been inside the tubing for the weaker sands and through the annulus for other pay zones.

This type installation has proved satisfactory for wells located on land, but is not considered desirable for dual completion of wells located in open bay waters. Reason lies in the inherent vulnerability to damage of such wells by floating objects, with subsequent hazards and difficulty of maintenance. To provide maximum safety of operations and ease of servicing such wells, it is advantageous in offshore dual completions to:

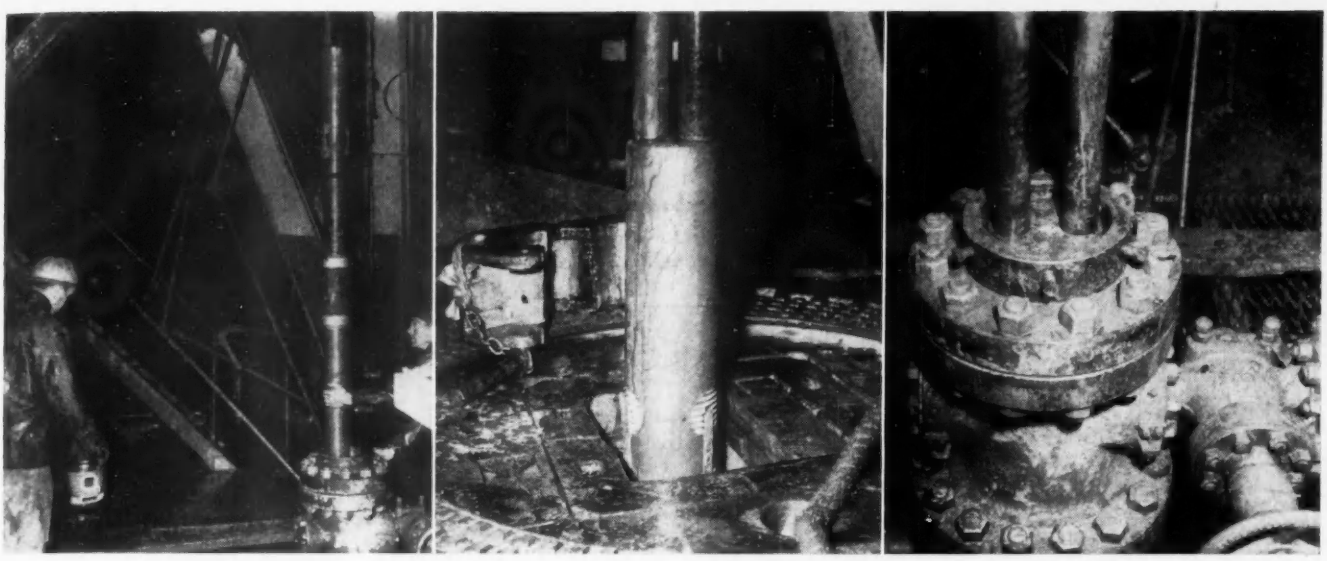
- Leave mud in the casing annulus with no pressure existing other than that due to the hydrostatic head of the mud column.
- Handle both zones separately at all times so they are never thrown together.
- Install storm chokes in both tubing strings so that they may be serviced separately.
- Be able to swab either zone at any time without interfering with production from the other.
- Produce the lower zone through tubing should water be present, thereby reducing possibility of loading up the producing string as badly as would be the case when producing through the casing annulus.

Well Head Problem. Parallel tubing strings have been run successfully in the past in various types of well completions. In hydraulically pumping oil, for example, it is necessary to run a power oil line parallel to the tubing. In most instances, these installations employed two different sizes of tubing, such as 2½-inch and 1¼-inch. Since packers were available for dual completions employing different size tubing strings, it was not difficult to adapt this design for two full size tubing strings.

But, the design of a well head assembly did pose a difficult problem in that master flow valves had to be installed in each string so that swabbing, running instruments, etc., could be handled safely. It was necessary to design and make a special head for this particular dual completion. An outline drawing of the first head is shown in Figure 1. In this installation, screw type fittings were used.

After this first tree was successfully installed, it was found that by making a special flange, which has the dimensions, except for thickness, of a two-inch, series 600, but, equivalent to a series 900, it would be possible to make a flanged tree. Subsequent dual completions of this nature will incorporate the flanged type tree.

The problem in well head design was to allow a straight through full tubing opening for both strings, and yet have adequate space for storm chokes. It was necessary that storm chokes be installed, serviced and the



Running in the pin packer hold-down (left) through flanged pack-off head which served as blowout preventer during operation. Top of pin packer hold-down (center) showing 3-inch diameter button slips and top connection for both tubing strings. Dual string pack-off (right) which served as blowout preventer during running-in operations. Flange is shown bolted in place to form a seal around both tubing strings when operations had to be stopped during a storm.

well could be swabbed. In order to design a well head of this nature, it was necessary to set two joints of 7⅝-inch streamline casing at the top of the seven-inch production string. This size would allow sufficient spread between the strings above the tubing head for the installation of master valves. Below the streamline casing, 7-inch pipe was run to bottom. The parallel strings were made up of two-inch non-upset tubing to minimize clearance between them, thereby conserving space.

Drilling the Well. Well 2, State Tract 185, was spudded Oct. 8, 1952. A 20-inch conductor pipe was set at 120 feet and cemented with 200 sacks of cement. An intermediate string of 10¾-inch pipe was set at 1044 feet and cemented with 600 sacks of four percent gel cement. The well was drilled to a total depth of 5935 feet and the 7-inch string cemented at 5269 feet. One hundred fifty sacks of slow setting cement was pumped through the casing shoe and 525 sacks of four percent gel cement pumped through a differential valve circulating tool in the 7-inch string at 3694 feet. The well was perforated from 5222-5226 feet with six bullets per foot, and from 2823-2826 feet with six bullets per foot. The bottom pay, on a 30-minute drill stem test, had a shut-in bottom-hole pressure of 2350 pounds per square inch. The upper zone showed a shut-in bottom-hole pressure of 1250 pounds on a 30-minute drill stem test. Both zones are Miocene sands.

A middle zone, from 3605-3608 feet, was perforated and tested, but only mud and salt water were recovered. These perforations were squeeze cemented. A 6⅝-inch bit on two-inch special tubing was used to drill out the cement plug and the bridge plug. A casing scraper was run to insure a full hole and the mud was thoroughly conditioned.

Well Completion. A retrievable wire line packer which can be run either on wire line or on tubing was run in the well on special 2-inch pipe and set at 5210 feet. The packer was run in the hole with a setting mandrel and a set of jars, both of which were retrieved. A perforated "stinger," called the producing mandrel, was run on the bottom of 2½-inch tubing. This particular type packer can be removed by running a pulling mandrel on the bottom of tubing or wire line, and is unseated by jars. Packer size was 2½-inch by 7-inch.

After the packer was set, the setting mandrel was removed by use of the jars. The 2-inch tubing was picked up about 14 feet and the mud thoroughly conditioned again prior to pulling the tubing and laying it down.

The producing mandrel for the wire line packer was screwed into the 2½-inch tubing and 2437 feet of it was run in the hole through a blowout preventer which was later stripped off. A pin type packer and packer hold-down were then run in the well on top of the 2½-inch tubing placed below it.

This packer is of the anchor type which requires no rotation of the string to seat or unseat it. Shear pins of the desired strength determine at what tubing weight the pins will shear and place the sealing element in contact with the casing. Perforations above and below the pin packer permit fluid passage around the packer as it is run in the well. In order to provide two outlets for the dual string, a 2-inch inner flow tube was extended through the packer and hold-down. A cross section of the packer hold-down is shown in Figure 2. The adapter which accepts the two parallel strings is located on top of the hold-down. In the well, the hold-down is placed above the packer as shown in the subsurface cross section.

The hold-down prevents unseating the production "stinger" extending through the wire line packer in the bottom of the well, and also holds down the pin packer when a differential pressure exists across it. The hold-down is set when the pressure of the upper pay is greater than the hydrostatic pressure of the mud column in the casing annulus. Six 3-inch diameter button slips engage the casing to prevent movement of the tubing string.

Running Parallel Strings. Figure 3 is a schematic cross-section of the complete subsurface installation. A string of 2½-inch tubing was run between the wire line packer and the pin packer. In order to run the two strings of 2-inch non-upset tubing with maximum blowout protection, a special running head was installed. This dual string flange packoff consisted of two halves joined together by four dowel pins and held in place in the flange by six hold-down screws which passed over the top of the pack-off. The pack-off was always handy to be placed in the flange should the well begin kicking while

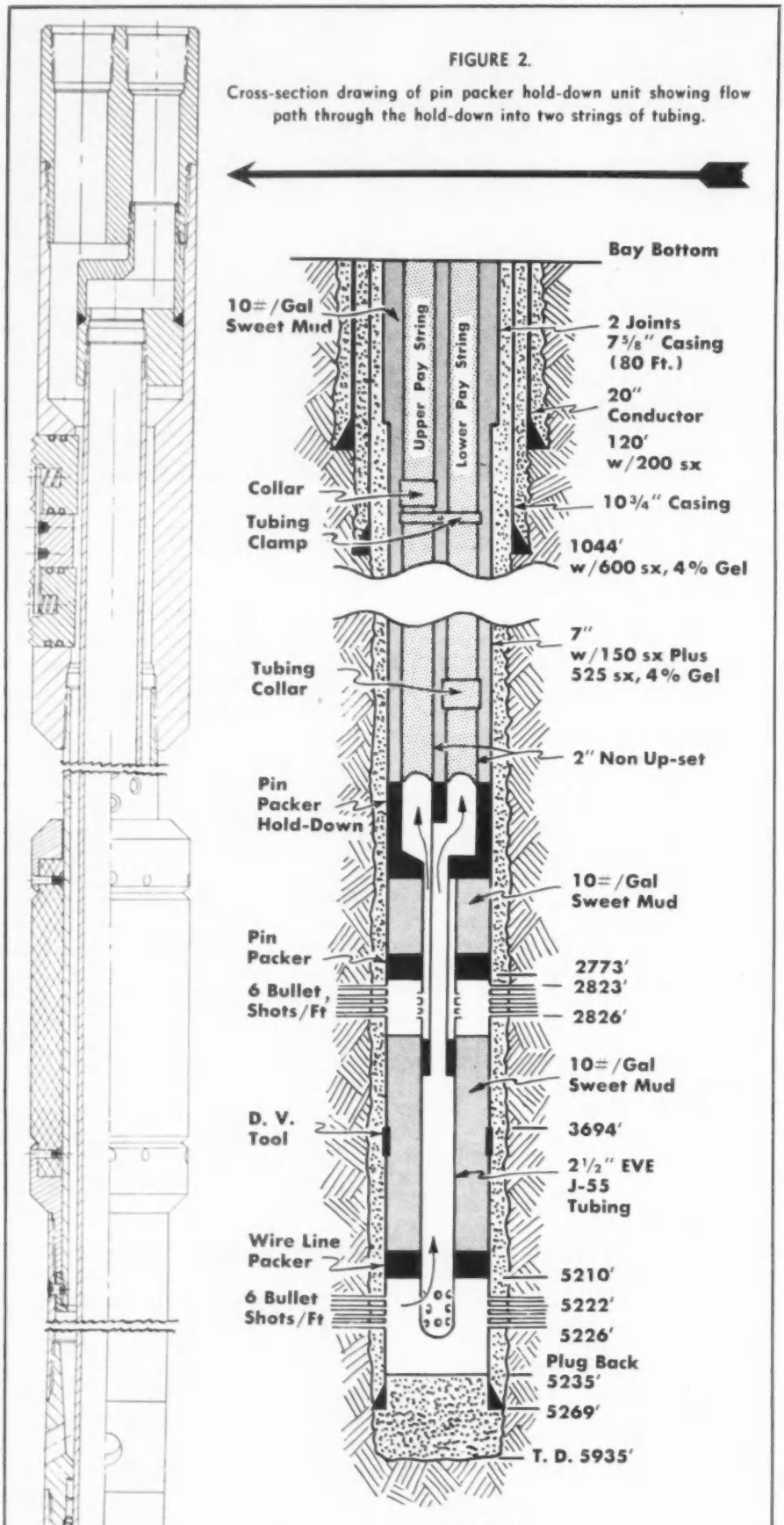


FIGURE 2.

Cross-section drawing of pin packer hold-down unit showing flow path through the hold-down into two strings of tubing.

FIGURE 3.

Schematic diagram of Alcoa Mining Company's dual completion with parallel tubing strings in its State Tract 185, Well 2, Steamboat Pass Field, Calhoun County, Texas.

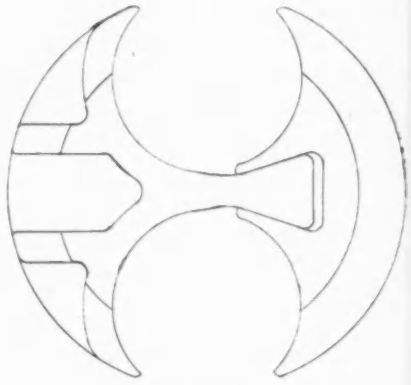


FIGURE 4.

Cross-section of 2⅜ by 2⅜-inch tubing clamp which holds the two strings together. The two sections are hammered together and then locked in place with an Allen-type screw.

running in the two strings of tubing.

In order to stagger the collars on the two parallel strings, a 10-foot pup joint plus a full joint of 2-inch tubing was screwed into the hold-down opening. This opening joined the flow tube passing through both the packer and hold-down, and connected to the 2½-inch tubing string below through which the lower zone produced. This string will be referred to as the long string. A full joint was then screwed into the short string opening in the top of the hold-down. By maintaining a relatively short distance between collars, picking up and lowering was minimized. Distance from the derrick floor to the flange on the casing spool was 17 feet which always placd the non-clamped short string collar above this flange. This feature of the operation eliminated any possibility of the short string collar hanging up in the flange and damaging the tubing or clamps. The tubing was then lowered by the elevators and the bowl was placed in the rotary table after the tubing joint on the short string was lowered past the table. Conventional tubing slips were set in the bowl and elevators released.

A special clamp (Figure 4) was installed just below the collar of the second, or carried in, string of pipe. A joint of tubing was picked up with a pickup line attached to the block and made up in the joint extending from the slips. The joint was spun in with a spinning rope in the usual manner.

The derrick man then locked the elevators around the pipe and the entire string picked up. Slips and bowl were removed and the tubing raised until the second string of tubing was about three feet above the rotary. A joint of tubing was picked

up with the catline and made up into this collar. A clamp was installed and the tubing lowered into the well until only the one string extended through the rotary. Tubing slips and bowl were again set around the string and the tubing suspended in the usual manner. This cycle was repeated until all the tubing was run in. The running in operation was successful and carried out without mishap.

When bottom was reached, the tubing was spaced with the proper weight on the upper packer, causing it to seat. The carried-in string of tubing was cut off approximately eight inches above the top of the tubing head flange and threaded to receive the master valve. After this master valve was installed, the tubing was picked up and the mud inside the short string was displaced with water. Both strings were then set on the slips inside the tubing head flange and the strain equalized on both strings. The other master valve was installed along with the remainder of the tree. Both completions were swabbed in without trouble and storm chokes placed in each string of tubing after the wells cleaned up. The long string was left filled with mud prior to cleaning for it was not desirable to pick up the weight of the string by means of the hand cut threads. Approximately 17,000 pounds of weight was set on the pin packer and 15,000 pounds suspended by the head. After the two zones were swabbed in, shut-in pressure of the upper pay was 1200 pounds; in the lower sand it was 1860 pounds. Casing pressure was zero, so it was evident that both packers were holding.

Other Applications. Since this installation permits desirable operating characteristics and is a safe one considering the hazards of offshore production, its application can extend to oil wells with equal success. In flowing wells which produce corrosive fluids, such a dual completion as described would prevent corrosion of casing above the top packer. Advantages of swabbing both zones independently, running bottom-hole pressure gauges, temperature bombs and bottom-hole samplers to the top of the pin packer are present. Should one zone require lifting, a slight modification of the upper packer would provide the benefits of a conventional pumping well combined with the flowing zone through a separate string.

ACKNOWLEDGMENT

The authors wish to thank Alcoa Mining Company for permission to publish this information, and to thank McEvoy Company and Brown Oil Tools Inc., for data and illustrations.

Subsurface Pressures

■ CONTINUED FROM PAGE 160

clearly indicated on the chart at "A." By close observation toward the end of the chart and after the entire load has been swabbed out, a very slow entry of fluid is indicated by the slow increase in pressure vs. time. In this case there was no apparent improvement in productivity.

Figure 12 (Chart 76547) shows just the opposite to the case in Figure 11. A cushion of 3000 feet of water was used. Formation delivery was slow with gas to surface two hours after the tool was opened. The well was acidized with subsurface indicated formation breakdown pressure of approximately 9000 psi at point "A." While swabbing the acid load the well started flowing gas and distillate which levelled off to a steady final subsurface flow pressure of 2298 psi. Increase in the flow of gas and distillate plus the increase in the subsurface flowing pressure and the indicated reliable closed in pressure of 3682 psi would well justify the time and money spent on this operation.

All testing jobs are not successful and the following charts illustrate two of the most comon job failures. Figure 13 (Chart 13224) represents a good example of bottom-hole choke plugging with lost circulation material. Each of the recordings as at "A" indicating a pressure buildup is caused by the choke being plugged. Each of the pressure decreases as at "B" is caused by the break-through and release of the pressure momentarily. Value of this test was nil as the recovery which was obtained was insufficient to base any conclusions; therefore, it would be classified as a misrun.

Two charts may be used to evaluate a test. These are shown in Figures 14a and 14b. These are charts from the top recorder (26276-BT 343) and from the bottom recorder (26276-BT 290). The instrument which recorded the top chart was located inside the test string above the packer and the other instrument was located below the packer and blanked off from the testing string. Immediately upon opening the tester valve the anchor perforations plugged and shut off all fluid entry into the testing string. The upper gage recorded only the weight of the water cushion plus the small amount of mud recovered due to the expansion of the mud below the packer when the hydrostatic pressure was released. This value shows no increase throughout the testing period and is disturbed only when the pressure breaks through momentarily as indicated by the "peeps" on the flowing line.

Check this record against the bottom chart where the tool was opened. Note a steady buildup of pressure broken only by the same "peeps" on the flowing line when a momentary break-through appears. When this pressure reached static formation pressure it remained stable for the remainder of the test. Value of this test is limited to the recorded closed in pressure only. If more information was desired this job would be classified as a misrun.

As can be seen by the relatively few charts which have been discussed, it is necessary to have a thorough knowledge of the basic tools and their auxiliary assemblies. Also, extreme care should be taken in preparation of the well prior to testing. Instruments used must be the best available both in accuracy and sensitivity. Chart reproductions must be an exact duplication of the original without falsification or retouching. With all the above adhered to, very intelligent study must be made of the charts, the recovery and all available data in order to obtain the full value of each drill stem test.

About the Author

C. C. OLSON joined Halliburton Oil Well Cementing Company in 1947, and since that time has been assigned to the management and development of the subsurface instruments in the testing department. In 1929 he was an engineer with the old ITIO Company (now Cities Service Oil Company) and worked on the first subsurface pressure recorder. During World War II, he served two years in the Navy in the South Pacific, was an instructor in electro hydraulics at Washington, D. C., and later transferred to Naval Petroleum Reserve No. 1 at Elk Hills, Tupman, Calif. There he set up methods for obtaining subsurface data. After the war he joined Signal Oil & Gas Company in California, and in 1947 became associated with Halliburton.

Here's what corrosion can do to tubing. Carbon dioxide corrosion of a tubing safety joint.

Don't Let Corrosion Eat Up Your Profits

What long has been regarded as inevitable in producing oil and gas can be avoided by an effective control program.

By DAN H. CARPENTER
Sohio Petroleum Company, Oklahoma City, Okla.

CORROSION CAN BE controlled profitably in practically all producing oil and gas wells. Through effective control, potential savings in equipment replacement, repair and well shutdowns are enormous. It is a problem of watching for and recognizing the source of trouble.

For years, many pools have been produced where lifting costs have been high, due chiefly to equipment corrosion. General reaction among some field production personnel in the past has been that these oils and waters "eat up" tubing, pipe, sucker rods and pumps, and it was an accepted fact that it was necessary to pull the wells often and replace considerable equipment. Unfortunately, in many of these areas, frequent pulling is still the practice, and the fact that it can be controlled is unrecognized.

Basic Causes. A corrosive environment existing in a well will be due generally to one or more of the following reasons:

- Corrosion caused by hydrogen sulfide in the system (sour oil or sour gas).
- Corrosion caused by the presence of carbon dioxide and organic acids.
- Electrolytic or galvanic corrosion caused by the presence of a galvanic cell in the well, or by stray electric currents entering or leaving the well.

Corrosive attack is a simple chemical or electro-chemical reaction with the metal. The reagents responsible for the corrosive attack are sometimes difficult to isolate.

Hydrogen sulfide is common and causes, in some instances, a phenomenon known as hydrogen embrittlement. This is the actual penetration of the metal by hydrogen, causing large pressures to be built up within the metal itself, thus weakening the metal and causing ultimate failure.

Carbon dioxide and organic acid corrosion is more frequent in gas or gas distillate wells. Production of as much as 0.2 percent of carbon dioxide will cause corrosion in deep high pressure gas or gas distillate wells.

In electrolytic or galvanic corrosion, the same action occurs as when metal is picked up by currents leaving one pole of an electric cell and depositing this metal on the opposite pole. A common method of combatting corrosion of this type is by the use of sacrificial metal or anodes, and is given the name, "cathodic protection." This

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has seldom been used in combatting subsurface equipment corrosion.

Measuring Rate of Corrosion. Pitting, rod breaks, cut-out chokes, tubing splits and leaks, gas lift valve and pump failures, may all be indications of corrosion. If a well is known or suspected to be corrosive, it is important to measure the rate of corrosion so that the necessity for control measures and the eventual effectiveness of these control measures can be evaluated.

One of the most common methods of predicting and investigating the rate of corrosion is by analysis of the produced brine to determine the dissolved iron content. Since some formation waters do contain dissolved iron, this method necessarily will not predict corrosion. In new areas, the presence of iron in brine would indicate the necessity for further investigation. Once the need for a corrosion control program is established, iron-in-brine tests are invaluable in checking the results of such a program. Even with iron in the formation water, it is possible to establish a datum line with no treatment to which can be compared iron-in-brine results subsequent to treatment.

Iron-in-brine tests cannot be used on sulfide wells, since the chemical reaction is such that water insoluble iron salts result.

The corrosion rate may be measured at a given point by exposing a preweighed coupon, pony rod, or pup joint to the corrosive environment for a given period of time. The test specimen is then removed and re-weighed. The corrosion rate in inches of penetration per year can be computed from the weight loss. Drawback to the use of test specimens is the expense involved in placing them in the well where the corrosion rate is usually highest and to the fact that they reflect corrosion rate only at the point of installation.

A third method of checking corrosion rate is the caliper survey. Tubing is checked for the number and depth of corrosion pits by means of a recording feeler device. The caliper survey will measure only the total amount of corrosion which has occurred. It is good for checking the effectiveness of protective measures when a previous survey has been run. If it is planned to use the caliper survey as a tool to check the effectiveness of a corrosion control program, the first survey should be run soon after the corrosion treatment has been started. Reason for this is that inhibitors will remove any rust, scale, and other corrosion by-products from the walls of the tubing. This will expose existing pits which might otherwise appear to have developed after the program was started.

Your casing may look like this unless preventive measures are taken. This pipe was removed after only five months of service.

In addition to determining corrosion rate, consideration must be given to determining the cause or causes of the corrosive environment. Inasmuch as not all preventive measures are effective in all of the known corrosive environments, the cause must be known before the most effective control can be selected. Use of Table 1 may be an aid in selecting protective measures.

Once the cause of corrosion and possible counter-measures have been determined, selection of the method to be used becomes a simple dollars-and-cents problem.

Corrosion Control Measures. The most widely used subsurface corrosion control measures fall into three general classes.

• Corrosion Resistant Materials. These materials include steel alloys of nickel, chromium and other metals, protective coatings of cement, plastics and non-metallic materials.

Before a decision is made to use alloy tubing, careful consideration should be given the use of all suppressive measures to determine which is actually the most economical.

Several protective coatings have been developed and show promise. Cement lined pipe is used extensively in disposal wells. Weight of this cement lining prevents its use in deep wells. Plastic tubing has been developed which is presently in service in shallow disposal wells. At present this material is limited by its physical properties to low pressure service and depths not greater than 3500 feet.

• Use of Neutralizers. These include caustic soda, soda ash, sodium hydroxide, sodium carbonate and others. Neutralizers are effective and efficient where the volume of produced brine is not very great. These compounds require continuous introduction of relatively large volumes of chemical, with resultant greater expense of equipment and labor. The volume of produced brine and its corrosiveness are the controlling factors in the expense involved.

The successful use of neutralizers depends on too many variables, such as the various salts occurring in the brine, volume of brine produced and acidity, for any simple rules to be enumerated for their use. When the use of neutralizers is considered, samples of the produced fluids should be submitted to a corrosion engineer for analysis and evaluation. Treatment with neutralizers involves lubricating fairly large volumes of fluid into the casing annulus continuously, and is not usually applicable to packed off or mudded off wells.

• Use of Inhibitors. Among the inhibitors are the chromates, formaldehyde and the semi-polar organic compounds marketed under various trade names. In the past, most corro-

sion problems have involved protecting wells already equipped, and in many cases well past their flush production stage. As a result, by far the majority of wells are now being treated with inhibitors such as chromates, formaldehyde and the semi-polar organic compounds.

Inhibiting qualities of chromates have been known and used for several years in many industries. They seem to "plate-out" on the surfaces, and at the same time make the brine less corrosive. Effectiveness of chromate depends largely on the character of produced fluids. When using chromates, care must be taken to keep them out of contact with the eyes and skin.

Organic inhibitors include formaldehyde and the proprietary semi-polar compounds. These compounds are absorbed on the metal surfaces to form a protective film. After the surface is covered with the inhibitor, no more can be absorbed and will pass out of the well with produced fluids to protect surface equipment or as waste.

For the purpose of applying inhibitors, various corrosive wells can be classified first, as those wells with packed-off or mudded-off casing which must be treated through the tubing; and second, those wells which can be treated through the casing annulus.

All treatment with inhibitors, and particularly with semi-polar organic inhibitors, is basically the same, in that the wells are given a heavy initial treatment to establish the protective film. This treatment is followed by a periodic treatment with smaller amounts to replace and repair the film as it is worn off. Amount of this smaller periodic treatment is determined experimentally on each well, and depends upon a number of factors, such as rate of flow, sand produced and amounts of water and oil produced.

One method of treating wells falling in the first category above is treating with a stick form of organic inhibitor. This stick is 1¼ inches in diameter, and approximately 18 inches long. It is the equivalent of a quart of liquid chemical. It is introduced into the well by means of a stick lubricator placed on top of the tree.

A second method of treating wells in this first category applies only to gas or gas condensate wells. By means of a slugger pump, the chemical is pumped into the shut-in well rather rapidly, and the well is left shut in for a long enough period of time to allow the chemical to fall to the bottom.

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Still a third method of treating wells with packed-off casing annulus, is by means of a bottom-hole injection valve. This valve operates on differential pressure. The casing annulus is filled with a chemical and oil mixture. As additional chemical and oil mixture is pumped in at the surface, pressure in the annulus is built up and an equal volume of chemical and oil is forced into the tubing just above the packer through the injection valve.

Corrosive wells having an open casing annulus permits introduction of chemical directly into the annulus. Treatment of this type well is simple in that the chemical with a diluent is poured, or introduced, by means of a batch lubricator, into the casing annulus. Well fluids are circulated back into the annulus for a long enough period to wash the chemical around.

Some difficulty has been encountered in treating wells of this second category because of high fluid level. In order to overcome this difficulty, it is necessary to circulate the well for a considerable length of time, or to equip the well so that a small stream of the produced fluids is returned continuously to the casing.

After treatment has been started and the coating established, the chemical should be introduced at a rate sufficient to maintain protection. The amount regularly used can be reduced, and the corrosion rate checked, until a minimum requirement is found. In this connection it should be remembered that it will take at least three weeks for oil wells, and longer for gas wells, for a change in the amount of chemical to affect the corrosion rate.

Frequency of Treatment. Frequency of treatment required can be determined by comparing the effect of frequency of treatment with corrosion rate. It will usually be found that treatment twice or three times a week will be sufficient for oil wells. Less frequent treatment should be checked for its effectiveness. In the treatment of gas wells, treatment once a week usually is sufficient. Treatment twice a month has been found to be very satisfactory on some wells.

Since most of the inhibitors in use selectively coat the exposed metal surfaces, any unused chemical is wasted. For this reason, heavy doses cannot be used to build up heavy coatings. Adequate protection depends on proper application of an adequate amount of chemical. Haphazard application of excessive quantities of inhibitor will not do the job.

New forms of the proprietary inhibitors are constantly being developed, which simplify their application to oil and gas wells. For this reason, the various treatments described above should be considered only as a guide to their possibilities. Actual selection of the type, make and form of inhibitor should be made immediately prior to treatment, on the advice of someone familiar with local conditions.

TABLE I
Effectiveness of Corrosion Control Measures

	PREVENTIVE MEASURES								
	CORROSION-RESISTANT MATERIALS						INHIBITORS		
Corrosion Causes	Nickel Alloys	Chrome Alloys	Plastic Asphalt Lining	Plastic Tubing	Cement Lining	Neutralizers	Formaldehyde	Chromates	Semi-Polar Organic Compounds
Low Pressure H_2S	P	E	E*	E	E	P	E	P	E
High Pressure H_2S	I	E	E*	U	E	P	E	P	E
Carbon Dioxide and Organic Acids	E	E	E*	E	E	E	I	E	E
Stray Currents	P	P	E*	E	E	I	I	?	E

* Satisfactory if no breaks occur in coating.
E—Effective. P—Partially Effective. I—Ineffective. U—Unsatisfactory.

Less Time

TO REMOVE PISTON

Piston may be withdrawn through the crankcase. No need to drain coolant or lubricating oil.

Less Time

TO GRIND VALVES

Cylinder head removed quickly. No oil tubes to disconnect. Intake and exhaust removed by 4 accessable nuts.

Less Time

TO REPLACE SLEEVE GASKET

A simple wooden block replaces special pulling tool.

Less Time

TO REPAIR GOVERNOR

Governor may be exchanged as quickly as a magneto.

On Location OVERHAU

A plain language Instructic and Parts Book comes wi each CSCO. It enables th operator to perform all m chanical repairs on locatic and to obtain correct pc numbers.

THE CONTINENTAL SUPPLY COMPANY, *General Offices:* DALLAS, TEXAS

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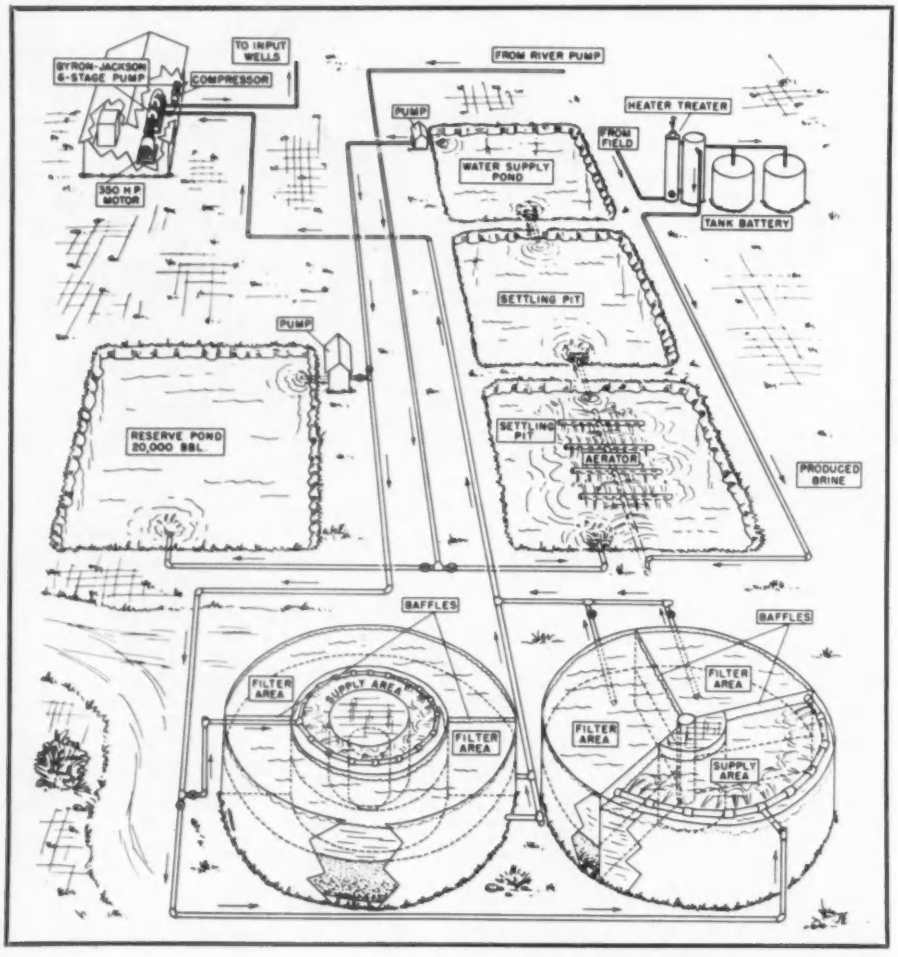


Courtesy Bureau of Mines, Bartlesville, Okla.

FIGURE 1.

Water treating system at Sinclair Oil and Gas Company's Security Flood, Nowata County, Okla. Two separate filter units used in slow filter water treating process are shown at bottom of drawing.

Nowata Water Floods Use Modern Techniques

Success of four projects in northeastern Oklahoma is attributed to the use of efficient equipment.

By ANTHONY GIBBON, WORLD OIL Staff

FOUR SEPARATE WATER flood projects in northeast Oklahoma's Nowata County have made impressive gains in oil recovery and increased profits to the operators. Much of the success can be attributed to the application of modern methods and efficient equipment. Once the site of pioneer water flooding in Oklahoma, Nowata County now contains four of the state's newer projects. All four floods have produced approximately two million barrels of oil as of June 1, 1952, through water injection.

They comprise about 1185 acres, and since they are relatively new, additional millions of barrels of oil are expected to be recovered before the floods are depleted. The projects are: Forest Oil Corporation's Flood 27; Delaware Consolidated Oil Company's Delaware Flood; The Pure Oil Company's Robbins-Fister Flood and Sinclair Oil and Gas Company's Security Flood. Location of each project is shown in Figure 1.

Forest Oil's Flood 27

Comprising 410 acres, this project is located in Sections 35 and 36, Township 26 north and Range 14 east. It is being flooded on the conventional five-spot pattern. Water was first injected into the Bartlesville sand topped at 1050 feet, in December, 1947. First oil increase was reported in July, 1948. About 30 feet of the sand is under pressure.

Drilling on the leases included in this project was begun in 1912 and initial average production was 20 barrels per day, ranging from as low as five to as much as 150 barrels. Wells were produced without regard to conservation of the original reservoir energy and production declined rapidly as the formation pressure was expended.

As rate of production fell below the economic limit, wells were plugged and abandoned and by 1929 relatively few producing wells remained in the area. Under primary methods and before the flood was started, the leases produced an estimated 1,665,000 barrels. Total oil recovery by water flooding will probably amount to 1,435,000 barrels, or nearly as much as by primary recovery methods.

Completion and Operating Methods. New input and oil-producing wells were drilled on a five-spot pattern with spacing of 440 feet between like wells. However, for economic reasons, some line-input wells were spaced at 660-foot intervals. Input wells were completed with 10 to 30 feet of 10-inch surface casing and with 1½-inch cement-lined tubing set on rag packers on top of the oil sand and cemented with 10 sacks of cement. Both water-input and oil-producing wells were shot with one to two quarts of nitroglycerine per foot of sand, the size of the shot depending upon the physical characteristics of the sand.

Each input well was equipped with a meter and regulating valve at the wellhead. Some oil producing wells on property lines or near surveyed locations in the pattern, were reconditioned with casing set and cemented with casing shoes at the top of the sand and equipped with tubing, rods and pumps. Most of the producing wells are allowed to flow; the others are pumped.

Source and Treatment of Flood Water. Fresh water from Curl Creek

is used for injection. Water is pumped through a six-inch pipe into an earthen 15,000-barrel-capacity settling pond near the water-treating plant. Produced brine gathered from the leases is returned to the settling pond to augment the supply of surface water. Mixed water is gravitated through the settling pond and over a step-type aerator into an earthen supply pond which holds 16,000 barrels. A 12,000-barrel back-wash pond provides retention time for sedimentation of the back-wash water from the filter.

Mixed waters are pumped from the supply pond into a 1000-barrel wooden treating tank containing baffles arranged to provide necessary mixing and retention time for the chemical treatment. Water is filtered in a 100-barrel wooden tank containing about 30 inches of fine sand supported on about 2½ feet of graded gravel. Filter rate is about 2½ gallons per minute per square foot of filter space. Filtered water gravitates into a 500-barrel wooden clear-water tank. The filter is backwashed every 24 hours with water from the clear-water tank by a centrifugal pump at an approximate rate of 17 gallons per minute per square foot of filter area.

Results. Several outstanding features have contributed to the success of this project. Simplicity of design and selection of proper equipment and capacity for the water-treating plant is a proved economy. Many of the wells, although relatively deep for Nowata County, were completed as flowing wells, affording an opportunity to control rates of fluid extraction, dampen by passing and eliminate many costly mechanical difficulties inherent with pumping.

Up to June 1, 1952, more than 1 million barrels of oil, or in excess of 2400 barrels per acre, had been produced. Total oil recovery probably will approach 3500 barrels per acre as compared with 2686 barrels per acre produced by primary methods.

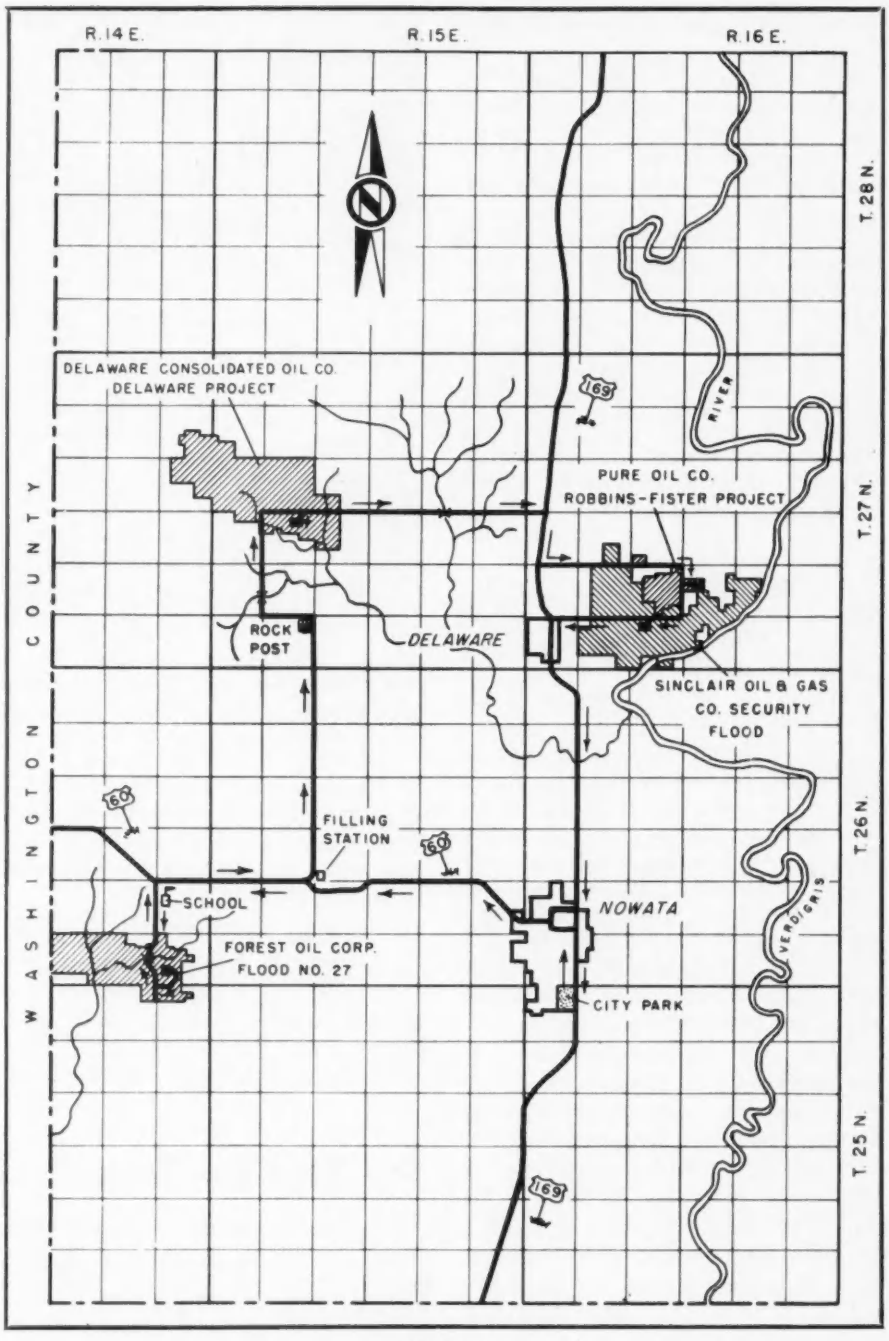


FIGURE 2.
Area of Nowata County showing locations of four water flood projects described.

Delaware Consolidated's Delaware Flood

This project is located in Sections 17 and 20, Township 27 north, Range 15 east, and comprises 200 acres. The Bartlesville sand, topped at 1042 feet and averaging 32 feet in thickness, is under flood. First water was injected in September, 1949, and the first oil increase was noted in January, 1950.

History Prior to Flooding. Lease development started in 1909 and annual oil production reached a peak of 1,670,000 barrels in 1911, but production dropped sharply the following year to 413,000 barrels. Vacuum was applied to all wells with little effect in increasing production rates.

In 1926 air and gas injection was begun when production had declined to 23,800 barrels annually. By 1929 production had increased to 62,800 barrels a year and was maintained at this level for several years. Gas and air injection was continued until the beginning of waterflooding when all the old wells were plugged and abandoned.

By primary methods alone about 3,180,000 barrels of oil would have been recovered before the economic limit was reached about 1932. Air and gas injection has resulted in the recovery of an estimated additional 916,000 barrels resulting in an estimated pre-flood recovery of 4.1 million barrels of oil.

Completion and Operating Methods. All wells were drilled with cable tools on a five-spot pattern with a 660-acre spacing between like wells. The sand is deeper in this area than in most parts of the county, accounting for the wider spacing pattern. All wells are equipped with individual pumping units. Oil wells were completed with 5½-inch casing set and cemented at the top of the sand and

pumped through 2- or 2½-inch tubing.

In recently completed input wells, 10 to 30 feet of surface casing was used and 2-inch tubing set on top of the sand on a disk-type rubber packer and cemented with 15 sacks of cement. Both input and producing wells were shot with 0.6 to 1 quart of nitroglycerine per foot of sand. Each input well is equipped with a water flood-type meter with a regulating valve enclosed in a rectangular concrete meter box having an insulated wooden cover to protect against freezing.

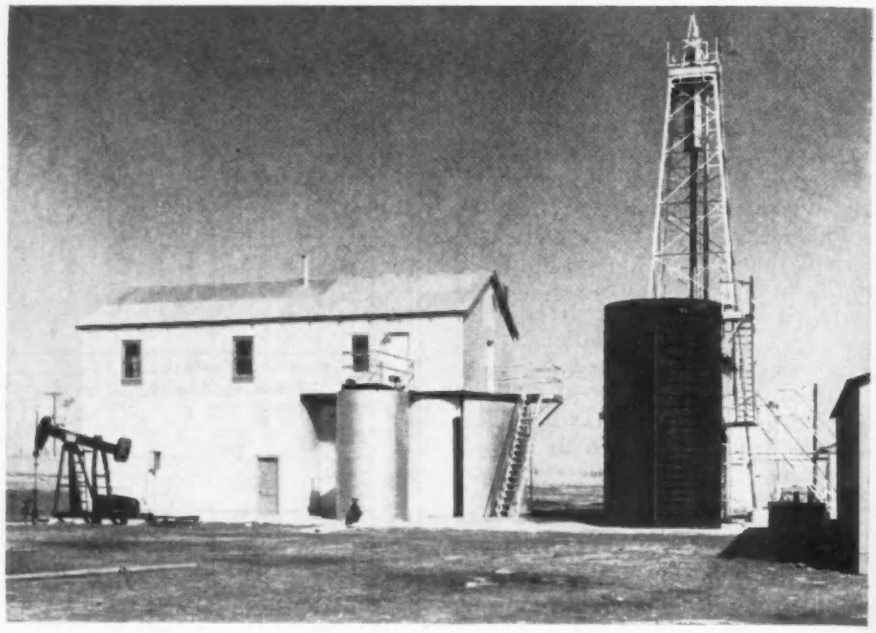
Source and Treatment of Water. Injection water is provided by a 2509-foot deep Arbuckle limestone well with pump set at 1183 feet. The well has a tested productive capacity of approximately 15,000 barrels per day. Water is pumped from the supply pond by a centrifugal pump to a 600-gallon per minute accelator where it is chemically treated, mixed, coagulated and clarified.

The accelator is essentially a tank into which the raw water is introduced and mixed with lime, ferric sulfate and chlorine. Primary and secondary mixing and reacting zones are provided, as well as a concentration area where the slurry is accumulated and periodically discharged from the tank by valves automatically actuated by compressed air from a small compressor in the pumphouse.

Fluid is mixed and recirculated in the accelator by an electrically-driven rotor-impeller. Lime is added to the water to remove a large percentage of the carbonate constituents. Ferric sulfate reacts with lime to form a floc which improves the removal of solids by sedimentation and improves filtration. Chlorine removes the remaining traces of hydrogen sulfide and prevents bacterial and algal growths.

Clarified water flows from the top of the accelator into a 100-barrel steel surge tank where it passes through a weir box equipped with an electrical control head which automatically controls the motors of the chemical feeders and the chlorinator. Water from the surge tank is pumped through two pressure sand filters connected in parallel. Each filter is backwashed, as needed, about every two or three days. Filtered water is discharged into a steel clear-water 1000-barrel capacity tank. A float in the tank controls the action of the filter pump.

Cathodic protection utilizing an outside source of electric power minimizes corrosion in the steel clear-water tank.



Delaware Consolidated Oil Company's Delaware Flood. At right is original pilot plant consisting of hydrogen sulfide oxidizing tank, accelator stabilizer and de-aeration tower. Chemical building is behind tank. Installation at left is essentially the same but larger and now services entire project.

Water from the clear-water tank flows through a 16-inch header to two inverted quintuplex pumps equipped with porcelain plungers. Internal corrosion in these pumps is minimized by cathodic ion protection provided by magnesium anodes which are inserted in the plunger chest of the pump. Pumps are powered by 150-horsepower, 440-volt, three-phase electric motors.

Results. First increase in oil production occurred in January, 1950, and continued to increase through 1950 and 1951. Drilling and development under the present program were continuous and the flood has been expanded gradually. Up to June 1, 1952, over 235,000 barrels of oil had been produced through injection of 3.8 million barrels of water. This is equivalent to a water-oil ratio of 17 to 1.

The Pure Oil Company's Robbins-Fister Flood

Located in Sections 27 and 28, Township 27 north and Range 16 east, this flood comprises 115 acres and formation under flood is 31 feet of Bartlesville sand topped at 700 feet. Water was first injected in April, 1951, and the first increase in oil production was reported in June, 1951.

History Before Flooding. Most of the original drilling occurred in 1909 when peak annual oil production totalled over 198,000 barrels. In 1913, vacuum was applied increasing oil production rate, but this was discontinued in 1931. It is estimated that application of vacuum resulted in the recovery of 175,000 barrels of additional oil that would not have been recovered under previous production methods. Oil production declined gradually until 1927 when gas injection was begun. As a result of gas injection the yearly rate of oil production increased from 16,250 barrels in 1927 to approximately 52,000 barrels in 1930.

From this peak, oil production declined gradually until 1951 when waterflood was started. It is estimated that, at the time water flooding was begun on these leases, gas injection had resulted in the recovery of more than 690,000 barrels of oil in addition to the oil that would have been produced by primary-production methods supplemented by the use of vacuum.

Completion and Operating Methods. All old wells properly located in the five-spot pattern have been utilized both as water-input and oil-producing wells, having been cleaned out, reshot when necessary, and recompleted. New oil wells were drilled with cable tools and completed for flowing wells. The first oil wells were completed with surface casing and 1½-inch cement-

lined tubing set with rag packers and cemented at the top of the oil sand. Recently-completed producing wells were equipped with disc-rubber packers set on the two-inch tubing instead of the rag packers used formerly. These wells were cemented with 15 sacks of cement injected through a cementing string of tubing to effectively seal a portion of the annular space between the tubing and the open hole above the packer.

The first input wells were completed with 5½-inch casing set and cemented on top of the oil sand. Recently-drilled input wells were cased with 10 to 30 feet of 10-inch surface casing and completed with two-inch tubing and disc-rubber packers set at top of the oil sand and cemented with 15 sacks of cement. Both oil-producing and water-input wells were shot with 0.6 to 1 quart of nitroglycerine per foot of pay. Each water-input well is equipped with a water-flood meter and regulating valve enclosed in concrete box with insulated wooden cover to protect against freezing.

Source and Treatment of Water. Water for this project is provided by a 15,000-barrel daily capacity water well drilled in the Arbuckle limestone to a depth of 1797 feet. Brine is produced through 5½-inch casing by means of a 125-horsepower subsurface electric motor connected to a multi-stage centrifugal pump set at 1029 feet. Water is pumped through six-inch asbestos-cement pipe to an aerator, then through a wooden aerating tower equipped with wooden baffles through which an electric blower passes air at the rate of 2400 cubic feet per minute.

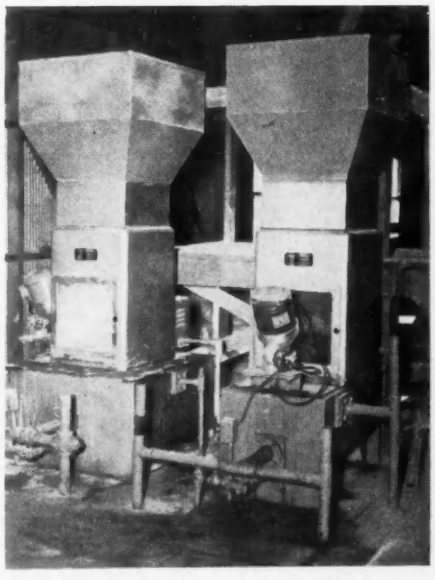
During aeration, most of the dissolved hydrogen sulfide is removed. From the bottom of the tower, the water flows through a wooden trough equipped with baffles into a large earthen aerating pond holding approximately 10,000 barrels. This pond provides a detention time of about 30 hours for further aeration and settling. A centrifugal pump lifts the water from the aerating pond to the top of a second aerating tower (similarly equipped with baffles, trays and blower) on the top of an accelator tank where the hydrogen sulfide is further diminished.

Water treating by the accelator process combines mixing, coagulation and clarification into a single unit. Raw water from the aerator enters the tank in the slurry zone and passes into the primary mixing and reaction zone where dry chemicals are added. Lime, acidic ferric sulfate and chlorine are used to stabilize respectively carbonate constituents and neutralize the water, as a coagulant, and prevent growth of organic matter.

Water stabilization plant at The Pure Oil Company's Robbins-Fister Flood. At left, water tank; forced draft aerator and chemical house mounted above accelator. Large building houses the pressure filters and water injection pumps and to right is treated-water storage tank.

A rotary impeller forces the water upward through a secondary mixing and reaction zone over the draft tubes into the settling or sedimentation zone. In this area the sludge is concentrated and periodically drawn off while the treated water flows into a surge tank from which it is pumped through the filters into a clear-water well or storage tank.

The surge tank is a 100-barrel capacity welded-steel tank eight feet in diameter and 13 feet in height that serves only as storage before filtering. The fluid-level control in this tank automatically regulates the flow of water through the plant and the rate at which the dry chemicals and the chlorine are fed into the accelator. From the storage tank, water is pumped through three 8½-foot-diameter, closed, pressure-type filters filled with sand and gravel and connected in parallel.



Chemical feeders at Delaware Consolidated Oil Company's Delaware Flood project for feeding coagulant and lime into water stabilizer mechanism.

Filters are backwashed when necessary. At the existing 7000 barrels daily throughput, this is only necessary once every 10 days or two weeks. Backwash water from the filters and sludge from the accelator are disposed of in a separate pond. The clear-water tank or well into which water flows from the filters is a 1000-barrel steel tank in which excessive corrosion is minimized by cathodic protection utilizing an external source of electric power.

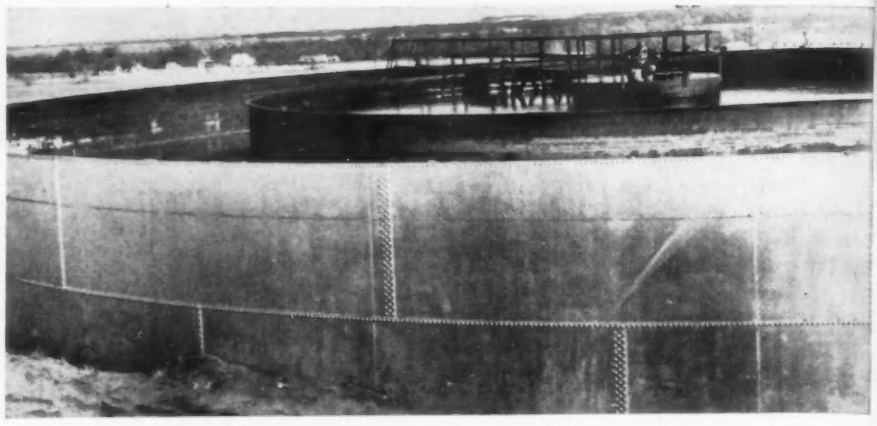
A 10-inch steel pipe line from the clear-water tank carries treated water to three horizontal reciprocating pumps equipped with porcelain plungers and each driven by a 50-horsepower electric motor. The plant is completely equipped with electically controlled devices, such as automatic starting mechanisms, float valves and shut-offs. Time relays are used in many of the circuits to obtain minimum power demand. A compressor unit supplies compressed air to a small closed system which motivates the floating controls.

Results. Water was first injected late in April, 1951, and the first effect was noted in June, 1951, when oil production rates increased substantially. Over 42,000 barrels of oil was gained during the short period of operation in 1951 and cumulative production up to June 1, 1952, is reported at approximately 100,000 barrels. At the end of 1951, water-injected-oil-produced ratio was 27/1 but this value began dropping sharply as "fill up" was being attained, and the ratio was less than 14/1 for the last month of 1951.

Sinclair Oil and Gas' Security Flood

This flood is located in Sections 32 and 33, Township 26 north, Range 17

east and comprises 460 acres. The Bartlesville sand topped at 650 feet and 25 feet thick is under flood. Well pattern is the usual five-spot (440 x 440 feet and 330 x 440 feet). The project began as a 40-acre pilot operation in February, 1948, and has been expanded to its present size. Unique features are the use of gas-injection wells as water-input wells and the method of water treatment by the slow filter process.



Filter unit tank at Sinclair Oil and Gas Company's Security Flood. This is part of unique method of water treatment by slow filter process.

History Before Flooding. Most of the leases were drilled initially in 1907 and annual peak production of over 500,000 barrels was reached in 1908 after which it declined rapidly until 1913 when vacuum was applied. Gas injection was tried on scattered leases in 1925 resulting in some increase in production before 1932. This was followed by an intensive air- and gas-injection program which increased production to 179,000 barrels in 1937.

Completion and Operating Methods. Original oil wells and those drilled during air and gas injection were completed with 6⅝-inch casing set on top of the sand. Original wells were shot with two to four quarts of nitroglycerine per foot of sand while those drilled during air- and gas-injection operations were shot with one quart of nitro per foot of sand.

Old producing wells on each lease were pumped until water flooding was begun on that lease, when they were concerted to flowing wells by cementing 2-inch tubing set on packers at the top of the sand. Several old wells were retained as pumping wells.

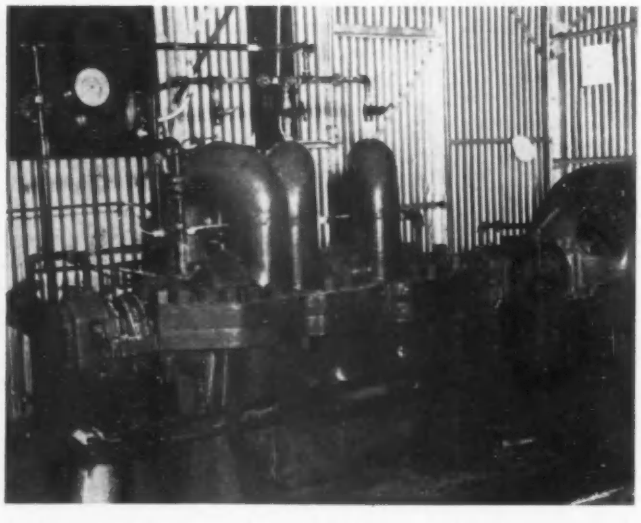
Wells used for gas-injection were completed by setting 4-inch line pipe on 4-inch collars at the top of the sand and filling the annulus with mud. These wells were converted to water input wells by setting 2-inch tubing with rag packers at the top of the sand and cementing with 10 to 15 sacks of cement. The newly-drilled water-input wells were completed with 2-inch tubing and packers set and cemented at the top of the sand.

Source and Treatment of Water. Water from the Verdigris River is used for flooding and is pumped through a six-inch steel pipe line into a large 20,000-barrel capacity settling pond which serves also as a reserve storage pond. When the reserve pond is full, the river water is diverted into a series of three interconnected ponds, each holding approximately 10,000 barrels, where it is mixed with the produced brine from the tank batteries.

The produced brine is aerated by spraying into the pond. The suspended solids are allowed to settle out, and the mixed waters are pumped into the filter system. This is composed of two filter tanks constructed from the lower rings of 55,000-barrel steel tanks, approximately 115 feet in diameter and 10 to 12 feet in height.

In one filter unit (left, Figure 1) an inner tank, approximately 60 feet in diameter and of the same height, was constructed, in the center of which was placed a third and smaller tank about 15 feet in diameter. The annular space between the two outermost tanks contains a filter bed separated into two equal sections by baffles, permitting independent operation of each filter section. The second or intermediate tank acts as a settling and supply tank for incoming water. Water enters this section through a slotted concrete pipe secured to the upper inside edge of the tank and provides further aeration of the water. The third or center tank merely acts as a baffle to protect the filter bed from oil contamination.

The other filter unit (right, Figure 1) is composed of a single tank divided



High-pressure, six-stage, electrically-driven water injection pump at the Security Flood. Capacity is 18,000 barrels a day.

Exterior of Forest Oil Corporation's plant on its Flood 27.

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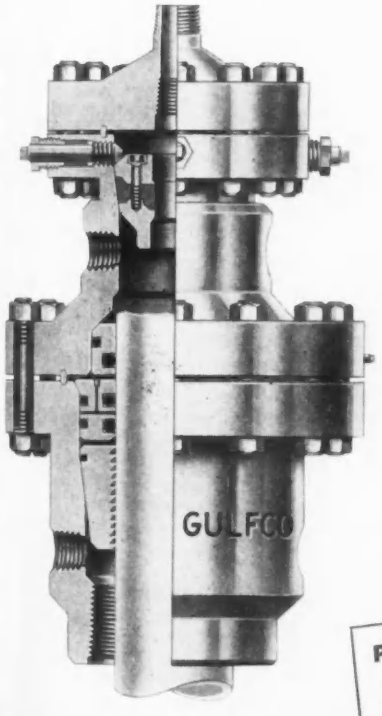
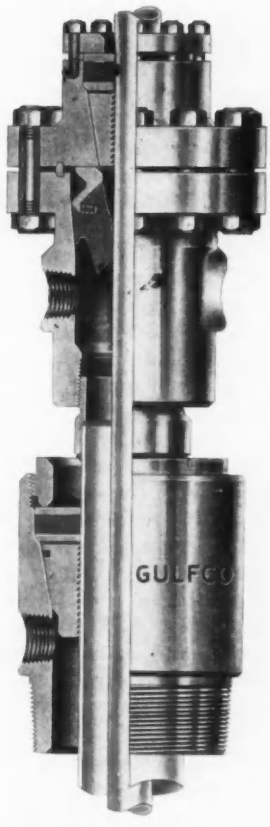
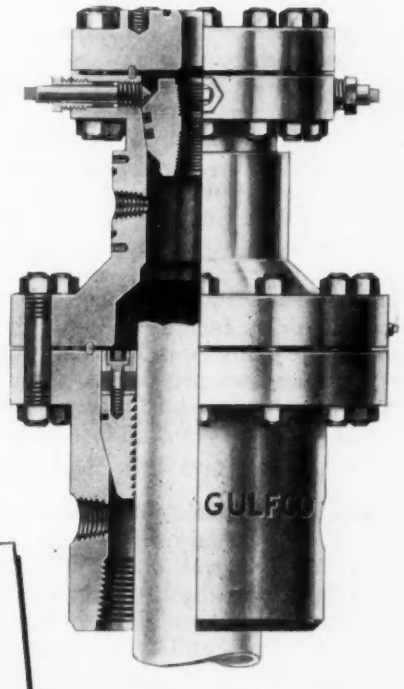


RS-4 Casing Head combined with G-2F ing Head Body, LA-2 Hanger, O-2 Seal G-2T Adapter Cap.



Type "CY" Casing Head with Type "CH" Weld Nipple combined with G-1 Tubing Head Body and G-6 attachment.



Type RS-1 Casing Head combined with G-2F Tubing Head Body, T-2 Hanger and G-2S Adapter Cap.

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by radial baffles into three sections, two of which form independent filter units, while the third segment functions as a settling area and source of water supply. Water enters this area through a slotted concrete pipe which provides further aeration and even distribution. In the center of the supply section, the same standpipe and under-baffle arrangement used in the first filter unit conveys water and protects the separate filter sections from contamination.

The filter beds in each of the units are alike and were designed especially for slow filtering. The filter is made up of a layer of filter sand approximately 30 inches thick overlaying a 3- to 5-inch thick layer of gravel supported by hollow rectangular tile which forms the underdrain system. The thin layer of gravel prevents plugging of the tile underdrains by the sand. The top of the filter sand is scraped mechanically once every four to six weeks to remove sediment as there are no backwashing facilities. The filters are constructed for independent operation of the separate filter areas while one or more of the sections are being cleaned.

Clear water from the filters flows by gravity through a nine-inch steel pipe line directly to a central pumping station for distribution to the input wells. A high-pressure, six-stage pump driven by a 350-horsepower electric motor pumps water at a pressure of 450 pounds per square inch into the field-distribution lines. Pump pressure is regulated by an air-controlled diaphragm governor. Compressed air is furnished by a small unit in the plant. Approximately 7000 barrels of water per day is pumped from this plant which has an estimated capacity of 18,000 barrels daily.

Results. A 40-acre pilot flood was started in February, 1948 and produced 83,000 barrels of oil by the end of 1949. The flood was then expanded to include the more than 460 acres now under flood and by June 1, 1952, about 7.7 million barrels of water had been injected and 432,635 barrels of oil recovered by flooding. From results obtained in the pilot operation, it is estimated that more than 1 million barrels of additional oil will be recovered from the project.

ACKNOWLEDGMENT

The author wishes to thank the Bureau of Mines for permission to use much of the above material from its Report of Investigation 4896 by John P. Powell and J. L. Eakin. Photos of the Delaware flood and The Pure Oil flood were furnished through the courtesy of R. P. Kuykendall, Infilco, Inc., Tulsa. Pictures of the Sinclair flood and Forest Oil flood by the Bureau of Mines, Bartlesville, Okla.

Permeability Determined From Production Data

By DR. DAVID CORNELL

Texas Petroleum Research Committee, University of Texas

PERMEABILITY OF A natural gas producing formation can be established by using a few intermediate data points during the first rate of flow when taking back-pressure tests on a well. Information required includes the properties of the reservoir gas at reservoir conditions, thickness of the producing formation, rate of production, and the decline of bottom-hole pressure with time while the well is flowing at a constant rate. The draw-down curve at the first rate of production may be used for these calculations. In this way, additional information can be obtained during a back-pressure test with only a small amount of effort.

Procedure. Draw-down data taken during the first rate of flow should be plotted on semi-log paper with $(p_s)^2$ as the abscissa on the coordinate scale and time as the ordinate on the logarithmic scale. As previously shown[2] the result should be a straight line on this type of plot after an initial adjustment period. Value of $(p_s)^2$ is then read at some time Θ and at a time 2Θ. For example, pressures could be established after 60 minutes and 120 minutes of flow.

It has been previously established[1] that $(p_s/p_f)^2$ will decrease by 0.0035 every time that Θ is doubled for a value of m (Equation 1) of 0.010.

$$m = \frac{(0.462)(\mu)(z)(R_c)(T)(Q)}{(h)(K)(p_f)^2} \quad (1)$$

The relationship between values of $(p_s/p_f)^2$ at Θ and 2Θ and m is given by Equation 2.

$$(p_s/p_f)^2_{\Theta} - (p_s/p_f)^2_{2\Theta} = (0.35)(m) \quad (2)$$

The bottom-hole pressure at, say 60 minutes and 120 minutes could be used to establish the value of m from equation 2. Permeability in millidarcies can then be computed directly from Equation 3.

$$K = \frac{(249)(\mu)(z)(T)(Q)}{(h)\left[(p_s)^2_{\Theta} - (p_s)^2_{2\Theta}\right]} \quad (3)$$

Example Calculation. Haymaker, Binckley and Burgess[3] give draw-down data taken on a natural gas well during a back-pressure test. These data have been plotted as a straight line on a plot of $(p_s/p_f)^2$ versus the logarithm of the time previously.[2] For this particular test the smoothed bottom-hole pressures at the end of 2.0 hours and 4.0 hours were 443.6 pounds per square inch absolute and 441.7 psia. Reservoir gas viscosity is estimated to be 0.012 centipoise, compressibility factor to be 0.94 and the formation temperature to be 551 degrees Rankine. The gas production rate was 514 thousand cubic feet per day. The permeability-feet for the producing zone then becomes:

$$hK = \frac{(249)(0.012)(0.94)(551)(514)}{(443.6^2 - 441.7^2)}$$

$$= 473 \text{ millidarcy-feet}$$

If, for example, the producing zone is 50 feet in thickness, the permeability computed from the draw-down curve would be 9.4 millidarcys.

Conclusions. The procedure for computing the permeability of a producing formation, provided the properties of the reservoir gas, the thickness of the producing formation, and a draw-down curve are available, is shown. An example calculation for actual data is given. The procedure may be made a part of a routine back pressure test readily.

ACKNOWLEDGMENT

This work was supported by the Texas Petroleum Research Committee at the University of Texas, Austin.

NOMENCLATURE

h	formation thickness, feet
K	permeability, millidarcies
m	$\frac{(0.462)(\mu)(z)(R_c)(T)(Q)}{(h)(K)(p_f)^2}$
p_s	bottom hole pressure, psia
p_f	shut-in formation pressure, psia
Q	rate of production, MCF/D at 14.7 psia and 60° F.
R_c	gas constant, 1545 (lb force)(ft) / (lb mole)(° Rankine)
T	bottom hole temperature, ° Rankine
z	compressibility factor
Θ	time, minutes
μ	viscosity, centipoise

REFERENCES

[1] "How to Determine Gas Well Performance Graphically," by Dr. David Cornell, WORLD OIL, Nov. 1952, p. 187.

[2] "New Method Estimates Gas Well Performance," by Dr. David Cornell, WORLD OIL, Jan. 1953, p. 180.

[3] "Methods of Establishing a Stabilized Back Pressure Curve for Gas Wells Producing from Reservoirs of Extremely Low Permeability," by E. R. Haymaker, C. E. Binckley, and F. R. Burgess, *Journal of Pet. Tech.*, Vol. 1, No. 71, 1949.

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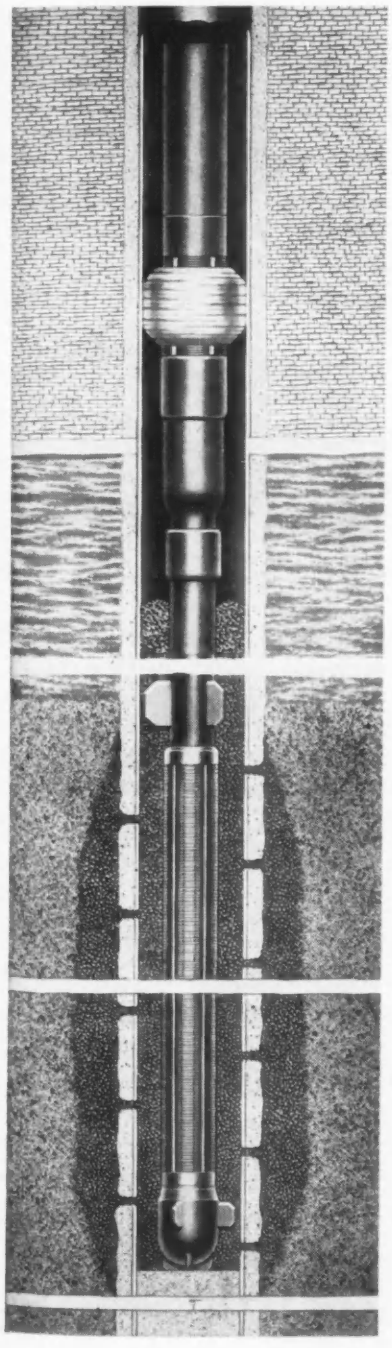

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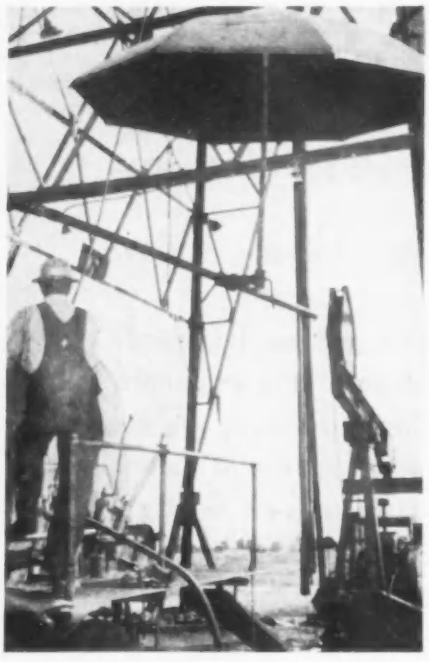
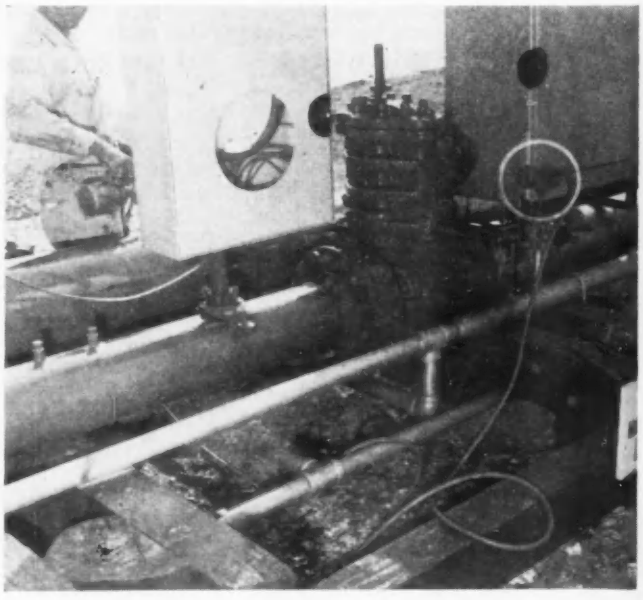


Umbrella Arm Is Easy to Adjust

An improved method of mounting the umbrella sheltering the hoist operator from either rain or the hot sun, may be built with only a few pieces of salvaged pipe and a little welding. In the installation shown, the mount starts with an upright length of three-inch pipe securely mounted between the hoist engine and the sand line reel. The supporting arm is a ten-foot length of two-inch pipe along which is run a tee, which in turn supports a combination tee and hand clamp holding the umbrella staff.

The arm may be swung through a wide angle, horizontally, and the staff support may be tilted to any angle to cope with practically any condition of sun angle. The unit is easily rigged up or torn down when moving from well to well and represents very little actual cost. It means much to the comfort of the hoist operator who is unable to move momentarily into a shady spot as can the floor men during odd moments in the course of pulling a well.

Gas Substituted for Paint Gun Air

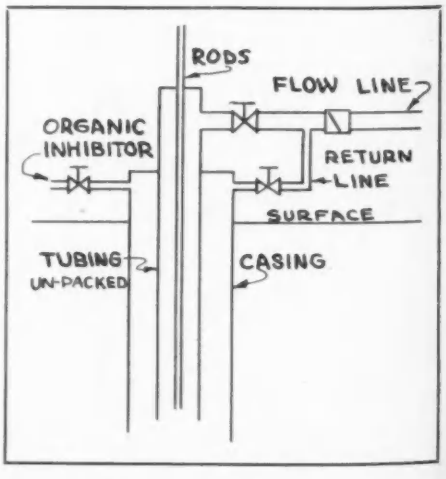


Natural gas can be used in paint spray guns to take the place of compressed air. On a remote location where it is costly to bring in portable air compressors, a pressure reducing valve, 75 feet of air hose and a quart capacity spray gun are the only tools required to paint a large gas gathering manifold.

On one of the two-inch lines that supplies gas for field use, a short riser is welded and a plug valve attached. Two reducers in this valve bring the size to ½-inch which allows the connection of a short ½-inch nipple attached to the pressure reducing valve normally used in welding service. A pressure gauge on the down stream side of the valve permits the regulation of exactly the amount of pressure needed for spray painting. With 75 feet of air hose, the painter can cover a large area and can paint a large pipe manifold in about one hour. At the pictured installation there was no shortage of gas and there was ample pressure, which enabled the painter to do the job quickly.

Of course, the disadvantage in such an operation lies in the fire hazard, and all precautions must be taken. Due to the remoteness of this location, such measures were simplified and only three men involved.

Inhibitor Stops Annulus Damage

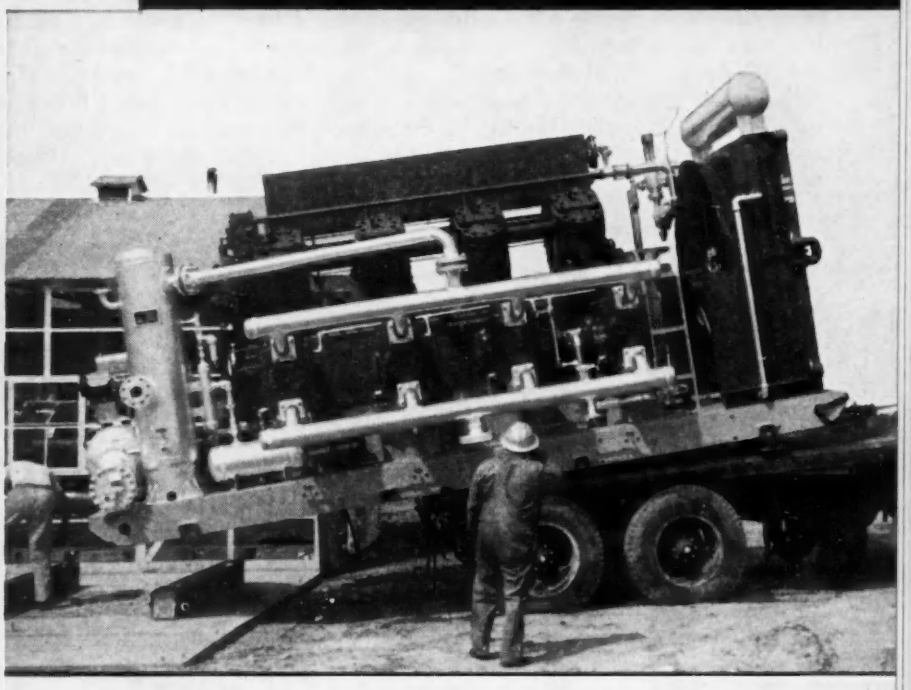


In high fluid level wells where the tubing is not packed off inside the casing, it is possible to achieve satisfactory corrosion mitigation by circulating inhibitors dumped in the annulus. In pumping wells particularly, unless the inhibitor is thoroughly mixed with the fluids in the annulus, little of the inhibitor will be drawn inside the

BEAIRD Ingersoll-Rand Packaged Compressor Plant

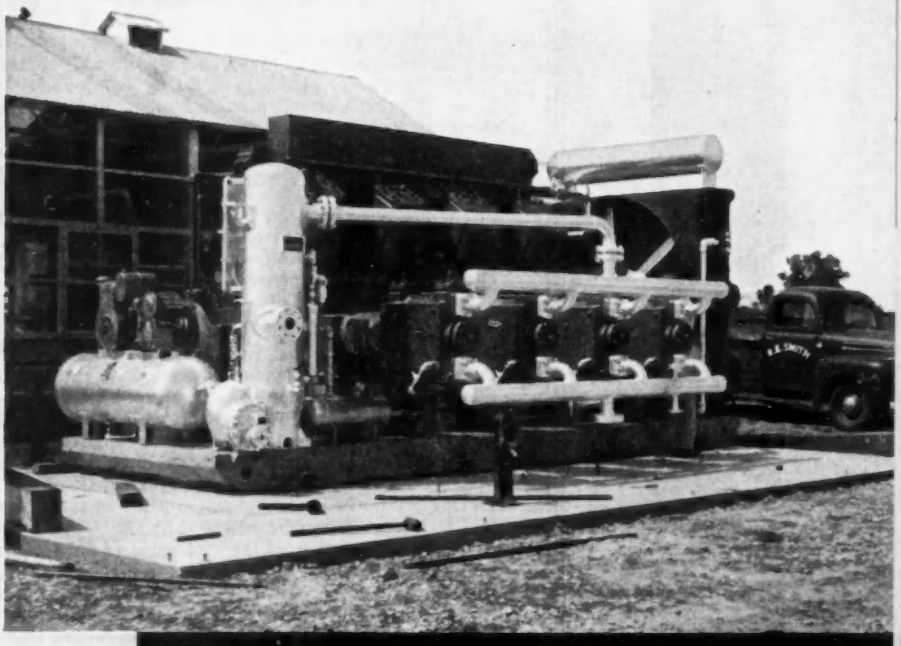
Straight from the Factory

This 440-horsepower packaged compressor plant was completely assembled at the factory — loaded onto a truck — and is shown as it arrived on location. There is no more assembling to be done — no more last minute fit-ups — no delay for missing parts — because the plant is complete to its last piece of piping. And look at the rigid steel base — how it permits the entire plant to be skidded off the road truck.



Ready to Connect up

The entire plant has been jacked down off of the blocks onto a simple concrete slab foundation. Now it's ready to be levelled, grouted, and connected to suction and discharge lines. A light shelter like the one covering the packaged plants in the background is all that is necessary to protect it from the weather — and there's no need to build a house for a regular attendant — the plant doesn't require one.



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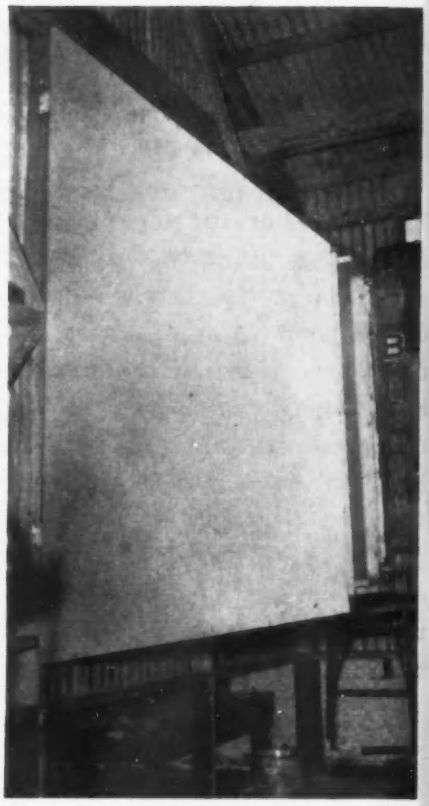
LP-GAS SYSTEMS

pump and up through the tubing where the protection against corrosion is desired.

If the tubing is not packed off, here is a simple yet effective method of providing adequate protection for pump, rods and tubing when the fluid level is relatively high. The inhibitor, whether it be of the organic type, chromates or formaldehydes, can be batch dumped into the casing annulus. Ordinarily, this inhibitor may remain inside the annulus on top of the fluids unless some means is provided for mixing the two together. In this manner, the inhibitor will be drawn into the pump at the bottom of the tubing which is submerged in the fluids.

A bypass or return line can be connected from the flow line as indicated in the schematic diagram and tied into the casing. A valve in the return line will control the amount of fluids pumped back into the casing annulus. This volume of returned fluid can be determined by basing on the degree of protection desired. As the inhibitor is dumped in the casing, fluids in the annulus are continually being recirculated so that a thorough mixing results. It is possible to close off the flow line completely at the battery so that all the fluids pumped will be recirculated back into the annulus and then into the pump again.



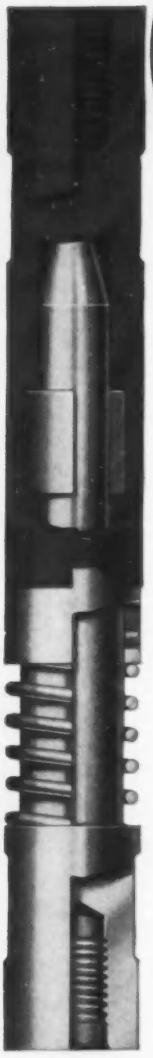
Enclosure Forms Air Duct To Cool Engine

A plywood enclosure which forms an air duct between a wall opening and the radiator of a multicylinder pump engine provided an aid in cooling an engine which formerly recirculated warm air inside the building. By framing an opening in the sheet metal wall and attaching the plywood sides to the radiator, the fan pulls in only the air from outside the structure. Since the opening in the wall is considerably larger than the area of the radiator, there is no obstruction to the flow of air into the radiator.

A wooden box frame fits the radiator snugly. The inner edges of this box are lined with a canvas strip that forms a seal against the radiator shell. One side of the plywood duct is hinged to the wall and only tacked to the other sides of the enclosure. In the winter, this hinged side can be swung back against the wall to allow recirculation of the air for additional heating. The entire structure is only temporary in construction and may be dismantled quickly in case of engine repairs, etc.

PAGE TENSION TOOLS

Easy engagement
Easy release
A RUGGED
Rod-to-Plunger Connection



PAGE
ON & OFF
ATTACHMENT

THAT'S THE PAGE

SUCKER ROD ON and OFF ATTACHMENT

The Page On & Off Attachment provides a quick, effective means of joining sucker rods to the pump plunger in tubing and casing pump installations. Its proven design permits removal and replacement of sucker rods without disturbing the pump plunger—a foolproof clutch-type locking mechanism eliminates chance for failure even under the severest of pumping conditions.

The success of the Page On & Off Attachment has prompted many operators to switch to larger volume pumps. The result—immediate payout for the changeover through increased production.

SIMPLE CONSTRUCTION—SIMPLE OPERATION!

Simplicity of construction is the keynote of the Page On & Off Attachment. There are no threads to gall, no complex mechanism to foul up. The tool consists of a male and female section which interfit and interlock when the sucker rods are lowered onto the pump plunger. A ¼ turn left rotates shoulders on the male section into milled out slots in the female section. During rotation a locking clutch engages by force of a helical spring positioned below it.

Disengagement of the tool requires only slight up strain and a ¼ turn right. This forces the clutching sleeve down and permits rotation of the female section for disengagement from the male section. Both the male and female sections are milled and turned from solid billits of steel and are held to close tolerances to virtually eliminate chance for wear.

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IN THE COMPOSITE CATALOG

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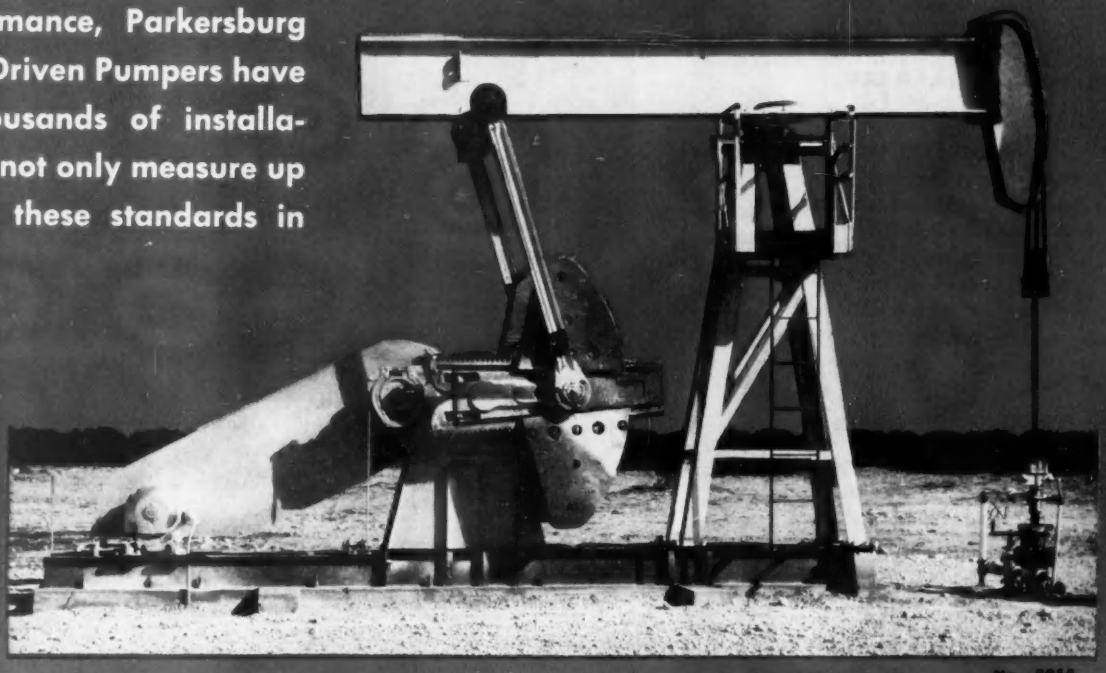

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ADJUSTABLE CRANK COUNTERBALANCE

can be furnished for both Gear and Chain Driven Pumpers having 48" and longer strokes.

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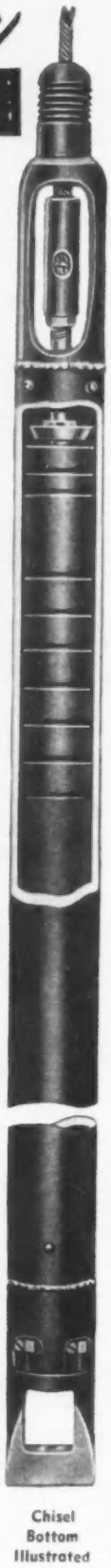

Chisel Bottom Illustrated

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5"
5½"
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20 feet
25 feet
30 feet

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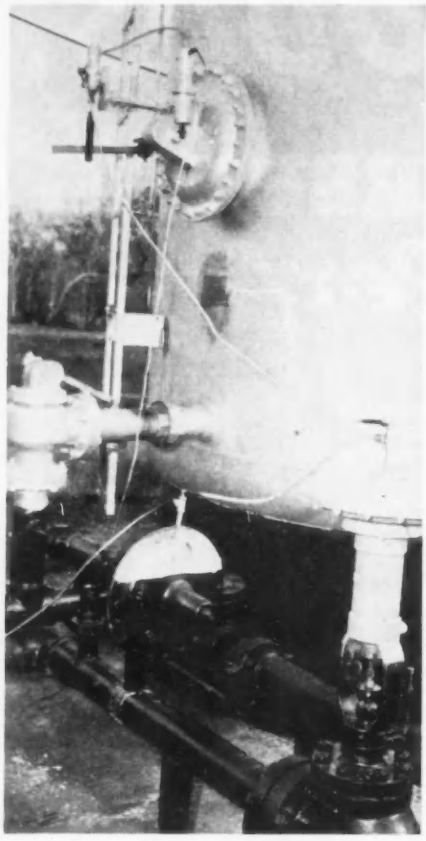


Regulators Control Disposal of Brine

A closed salt water disposal system incorporated an assembly of gas-operated regulators which automatically controlled the flow of brine through the system and into the disposal well. Since the injection of salt water is not a continuous process, an automatic method was devised so that brine could be circulated from the discharge back into the suction of the centrifugal pump. This pump was operating continuously, although it would speed up when pressure was needed for injection purposes.

Heart of the auto system is a pair of regulators: one placed in the pump discharge line leading to the disposal well, the other in a bypass line connecting the discharge with the suction. Gas control lines were connected in series to each valve. The underside of the diaphragm of the bypass valve was connected to the top side of the injection line valve. When control gas pressure was exerted in the small copper tubing, the bypass valve opened, and the discharge line valve closed. When pressure in the copper tubing was exhausted, the reverse occurred.

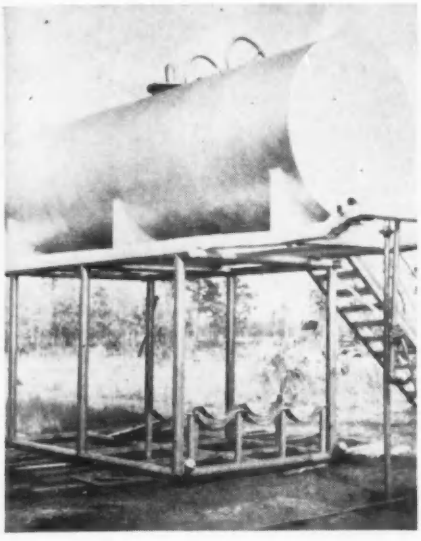
Control gas was supplied from the field gas system, and was reduced to about 20 pounds. A small sliding valve served as the controlling mechanism for both valves. In one position, it caused the diaphragms of the two valves to be pressurized; in the opposite position, it exhausted the control lines. This valve was operated by a float inside the accumulator tank of the closed system. As the water level in the accumulator tank dropped to a predetermined level, the control valve would cause the discharge line valve to close and the bypass valve to open. In this manner, the pump circulated salt water until the accumulator tank filled. At this point, the control lines were exhausted, causing the bypass valve to close and the discharge line valve to open, and water was injected into the disposal well.

Elevated Rack Makes Lube Handling Easy

Centralized storage of lubricating oil used by lease pumpers is simplified by one company which mounts a number of drums on an elevated rack. Each drum was connected into a common two-inch line to which, in turn, the loading hose is connected. With such a system, drums can be handled individually and rolled up into position for hooking into the manifold. With six drums hooked into the system, the oil supply lasts just six times longer than when a single drum is

opened and used until empty, then replaced by another.

Ready-made weather-proof vents are provided for each drum and, at the end of the rack, a gauge glass is installed so the amount of oil remaining is known at all times. The lower level of the rack is used for various other types of oil, solvents, etc., stored in single drum lots. The rack is made of two-inch pipe and is designed so as to permit moving and setting up at any convenient place beside the lease road or loading area.



Temporary Fuel Station Is Portable

A temporary fuel station for workover units, for centrally-located points in a field, or at the warehouse, may be constructed of two separate parts that are completely portable. The upper part of this fuel station is a horizontally-mounted tank, of about 150-barrel capacity which has been welded to saddles resting on pipe skids. The tank is equipped with a breather opening on top and with fill and discharge lines out the bottom.

The skid-mounted tank is supported by a framework made of four-inch pipe and braced as shown. Three pairs of saddles were added at the bottom of the supporting framework to mount three drums of lubricants in a horizontal position. These saddles were made of three-inch uprights and strap steel for the curved members.

A tank fill line was extended below ground to a riser at the front end of the tank. A swing joint and a short down line in which was placed a valve, served as a convenient method for filling the fuel tank by truck. The

NO!

Here, conventional U-Bolt clips are properly applied but rope is distorted and subject to life-shortening strains under load.

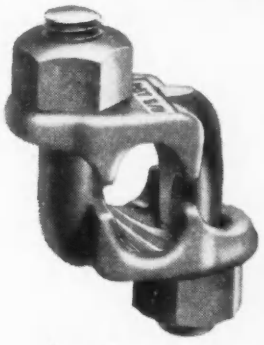
NO!

Inexperienced workmen can easily put conventional U-Bolt clips on incorrectly with saddles not on load-line. Result: Weakened rope — risk of accidents.

It CAN'T Go On Wrong

Both halves of the Laughlin Safety "Fist Grip"* clip are identical. There is no wrong way. The most careless workman can't put 'em on wrong (unless he forgets to tighten the nuts). And they're not only safer and practically foolproof, but they're a darn sight easier to use.

Here's why:



Nuts are out in the open, can be tightened with any wrench, and don't have to be "inched around."

Bolt ends are shorter and don't get battered or bent. Nuts are always easy to remove when clip is to be re-used.

No crushed rope ends under "Fist-Grips" to cut off. Rope saved.

Fewer clips are required in many installations, so there is less work to do.

"Fist-Grip" Clips are just one example of many LAUGHLIN EXCLUSIVES in design, safety and quality that make Laughlin your best buy in wire rope and chain fittings.

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THE THOMAS LAUGHLIN COMPANY
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THE MOST COMPLETE LINE OF WIRE ROPE AND CHAIN FITTINGS

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PUMPS

FIRST CHOICE for Secondary Recovery Water Flooding...

The lower the expense of producing source water from wells for water flooding operations, the greater the ultimate profit.

Reda Pumps for source water wells provide many ways for lowering these production costs.

Improved design and longer operating life *lower* the cost of labor per barrel, *lower* the cost of maintenance per barrel, *lower* the investment cost per barrel, *lower* the cost of fluid per barrel.

Also the ability of Reda pumps to produce greater volumes in limited casing sizes and from greater depths often reduces the number of source water wells required.

Reda engineers have long been associated with water flooding operations and are fully qualified to assist operators in discussing their source water requirements.

REDA

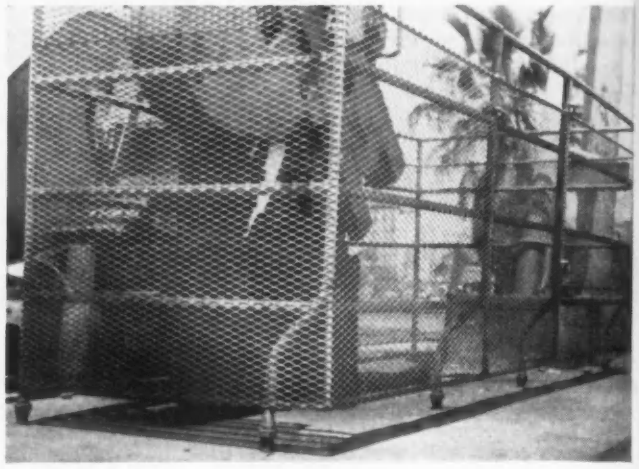
PUMP COMPANY

BARTLESVILLE, OKLA.

swing joint was connected to the discharge hose of the truck tank and fuel pumped into the elevated tank. A fuel discharge line from the tank was buried, and extended to the point of usage, which may be engines on a workover rig, or to discharge valves located a safe distance from the tank.

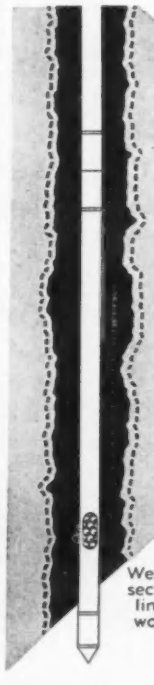
The entire assembly rests on heavy timber foundations, making the fuel station portable and easily set up or dismantled for moving.

Well Enclosure Is Easy to Move



Operation of pumping wells in an inhabited area carries with it the constant responsibility of insuring that children or passers-by do not venture too closely to the revolving counterweights or other moving equipment on the well. One company faced with this problem designed an enclosure that precludes this possibility, yet which is so mounted that the unit can be removed easily when work is to be done at the well.

The enclosure consists of a series of 1½-inch pipe legs and horizontal members to which are welded panels of heavy expanded metal. The lower end of each leg is equipped with a union which attaches to a corresponding nipple set in place at the time the concrete pad is poured. Skirt of the enclosure extends down to within less than a foot from the floor, thus precluding the possibility of a child crawling beneath the fence, yet allows the floor to be swept or hosed down as needed with but a minimum of floor obstructions to contend with. All horizontal bars are on the inside of the enclosure, making it difficult for anyone to climb over the high fence to gain entrance.



Well bore cross section. Dotted lines indicate wall reaming.

Clean Out Congested Wells

WITH BURCH AGATE TORPEDOES

Marble blasting pays because marble abrasion is thousands of times greater than sand blasting. It frees oil and gas in the well bore by removing all retarding substances from the true pay formation.

- CONDITIONS A WELL BORE OR SHOT HOLE BY RESTORING NATURAL FORMATION.
- ABRASION REAMING THE WALL CONTOUR DEEPER THAN RETARDMENT.
- EXPLOSIVE-DRIVEN GLASS MARBLES STRIKE THE WALLS WHOLE AND IN A UNIFORM PATTERN.
- 242 PER LINEAL FOOT OF HOLE.
- EACH MARBLE PENETRATES THE WALL SURFACE AND THEN BURSTS EXPLOSIVELY.
- DESIRED COLUMN TO COVER PAY IN ONE RUNNING CAN BE MADE WITH 5' SECTIONS.

Cross section view of torpedo

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BURCH Agate Torpedo

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Well Operations Are Recorded on Work Card

Much guesswork on the part of the pumper, and possibly costly errors, can be avoided in the operation of a string of pumping wells if an inexpensive technique employed by one company is followed. Attached to the guard rail of each well is a small sheet metal receptacle into which is slipped a card telling the well number, strokes per minute, length of stroke and such other information such as date, disposition of gas, etc.

This efficient system insures that relief pumpers, new men, or others directly concerned with a particular well's operation, can determine at a glance the correct operating conditions of that well and can adjust the speed or flow lines accordingly should conditions for any reason be found to be other than those recommended.

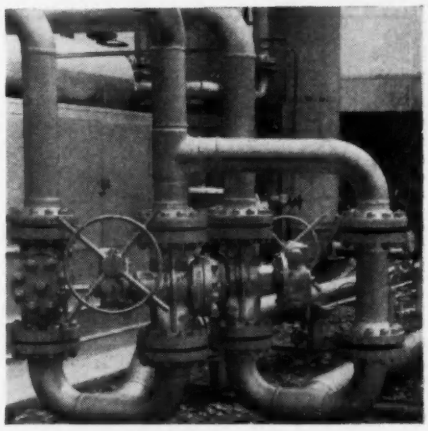
At any time that management wishes to change operating conditions, it is a simple matter to issue a new card and replace the old one. The system is helpful to the foreman or engineer, also, for, on inspecting a certain well, he can be acquainted with the recommended operating conditions at once and without having to carry voluminous records with him or be forced to return to the office to obtain the desired information.

Lines Are Hooked Up For Reverse Flow

Discharge piping on a solid dessicant type gas dehydration unit is so designed that one section of the unit can be reactivated by reversing the flow of hot gas through the saturated dessicant. When one section of the unit is being activated, another section is drying the gas.

In order to provide a dry gas for activating the saturated section, a cross-over connection must be made from the discharge lines of each dehydration section. Illustrated is a convenient and well-designed piping hookup to serve this purpose.

Of the three vertical eight-inch lines shown at left, the extreme left line is the discharge from one of the dessicant sections. The middle line is a direct bypass around the unit should it be necessary to completely cut out the dehydration unit. The third verti-



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cal eight-inch line is the discharge from the second dessicant section.

The horizontal eight-inch line at the left background is the return dry gas line leading to an indirect heater which steps up the gas temperature to reactivate either saturated section. A field meter station is tied into the far right horizontal line.

Extreme flexibility is provided in this arrangement. Dry gas coming from either dessicant section can be diverted into the heater line, or at least part of the discharge dry gas may be used for this purpose. Gas from an outside source may be directed in the heater line, or by manipulation of valves it may be flowed directly into the meter run. By arranging the valves and piping in this manner gas may be directed to any point desired.

Coming February 15
WORLD OIL'S REVIEW-FORECAST ISSUE

Read it for a complete 1953 forecast and a review of 1952 exploration, drilling, production and pipe line operations.

Portable Rig Floor Has Height Adjuster

Rotary tables on portable workover rigs have been joined to the derrick floor so they can be moved as a unit. Late improvements have added new features. One is the use of three-inch and four-inch pipe for

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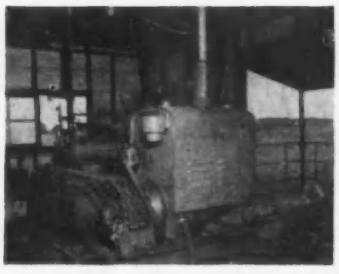

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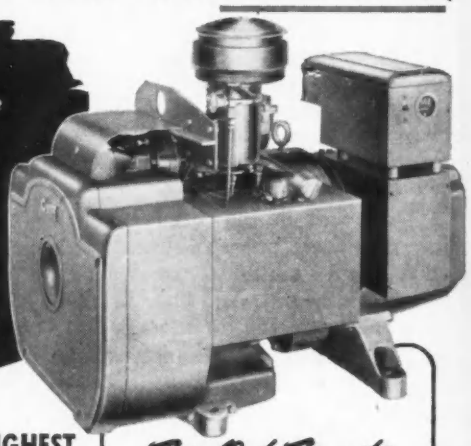

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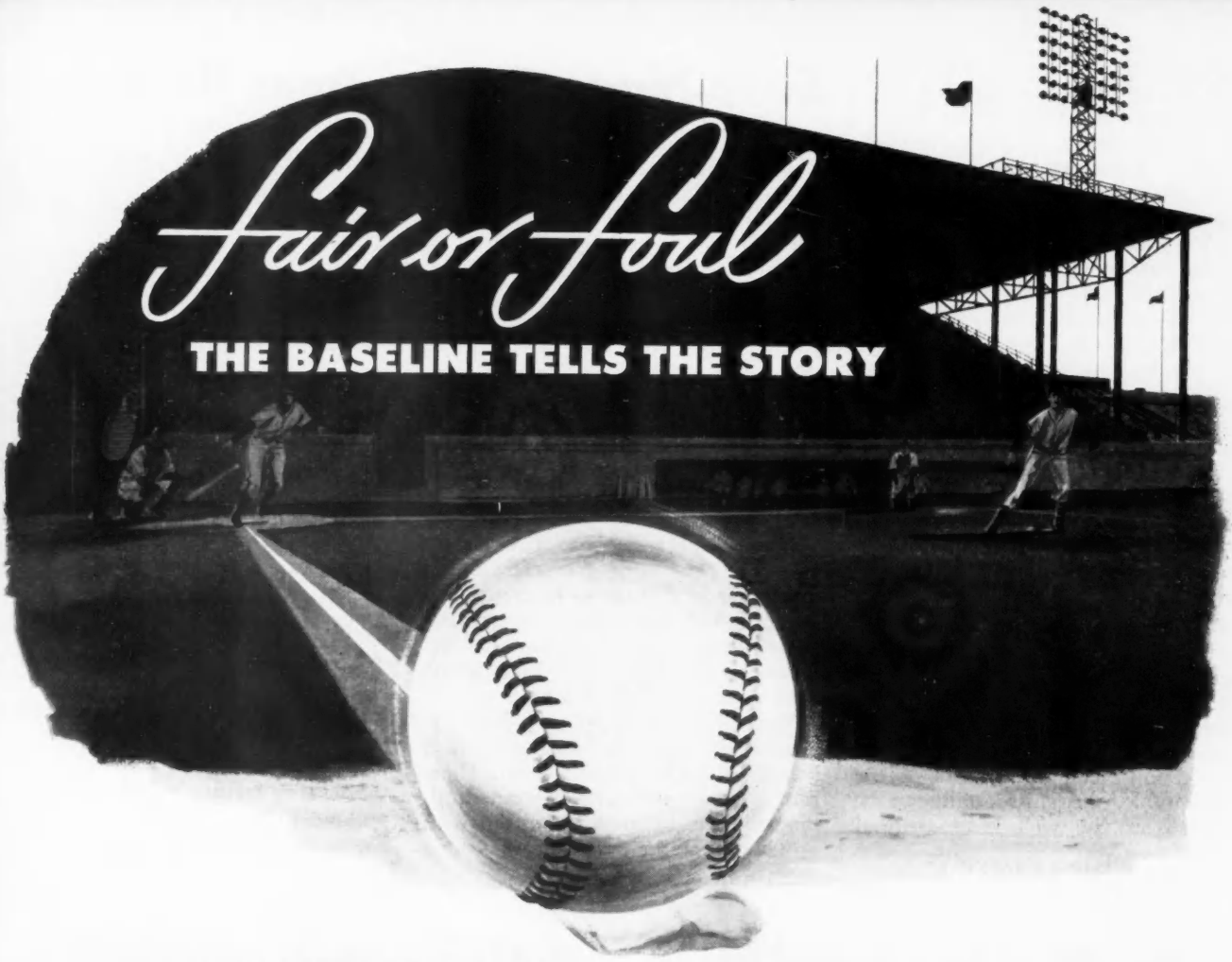
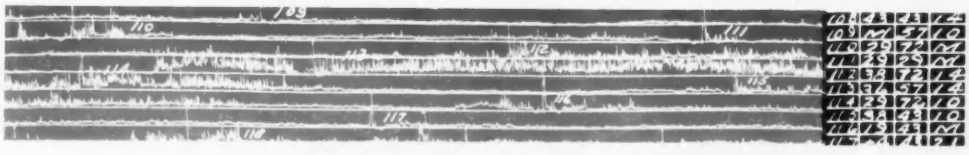


...only TUBOSCOPE calipers have the baseline



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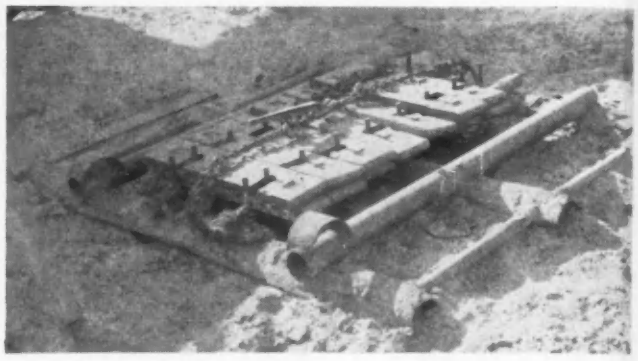
the upright pieces with the three-inch fitting down inside the four-inch so that the derrick floor can be raised if necessary. Normally the legs are in the collapsed position. But occasionally, after the blowout preventers are installed, the top of the upper leg will rest against the bottom of the rotary table, and here it is only necessary to raise the floor and slip pins through holes cut in the three-inch pieces. The pins rest on top of the four-inch corner pieces, which are well braced as shown.

Another feature is the folding catwalk along the side. The catwalk can be lowered when the rig is moved to bring the unit within legal road width. Braces on the bottom of the catwalks swing in and rest on the bottom of the I beams of the derrick floor when the rig is up.

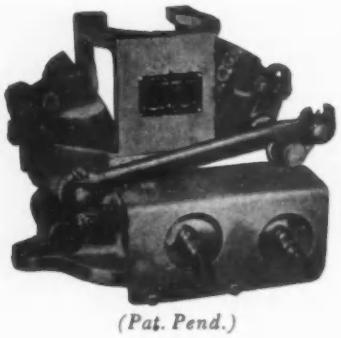
The third innovation is the slot or opening on the other side of the unit which allows easy installation and removal without disturbing the well head hookup. As long as the christmas tree or blowout preventer assembly will clear the bottom of the rotary table, the entire unit can be swung over the well head without lifting it.

Shop-Made Grader Does the Job



Smoothing roadways, locations and cleaning up around the well after pulling jobs or workovers is materially simplified with the aid of a shop-made grader. Made up of three half-sections of 8⅝-inch casing and tied together with spacers of smaller diameter pipe, the all-welded grader is similar to those frequently employed for lease grading work. However, the unit pictured differs somewhat in that the weights used are pumping unit counterweights and are so mounted as to permit easy shifting to any part of the grader to yield the most efficient grading action.

Welded to the upper surface of the grader are two parallel rows of short lengths of sucker rod material. These rods are so spaced as to permit dropping the weights over them, but with no chance of their shifting or falling off sideways. As can be noted, the weights are positioned so that they may be removed easily by lifting them upward. Position of the slots in the counterweights is reversed as each layer is placed over the rods. A chain lashed around them prevents their being bounced off when unusually rough areas are graded. A pair of loops welded to the leading edge of the scraper facilitates hooking up and pulling the unit with a tractor or truck.



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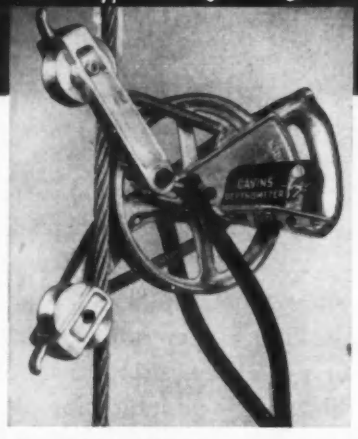

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- **Accurate Measurements**

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Progress in Products Pipe Lines

Now they're using

- **a "measured mile of pipe" to eliminate prover tanks for displacement meters**
- **a modified pipe line locator and fathometer to measure the cover on pipe under a river**
- **pigs to separate products and reduce contamination from 800 to about 60 barrels on a 240-mile 14-inch pipe line**
- **recorded voices to give depths of fluid in tanks**

By S. S. SMITH

Manager, Products Pipe Line Division
Shell Oil Company

A GREAT NUMBER of advances in pipe line technology during the past 12 months was revealed in a canvass of products pipe line companies. Outstanding achievements were in the fields of:

Electronics: Great Lakes Pipe Line Company has developed a remote gauging system making use of recordings on magnetic tapes to give the height of any tank. Plantation Pipe Line Company has made advances in electric gauging.

Determination of interfacial cuts: Standard Oil Company of California and Sinclair Pipe Line Company have been preoccupied with this problem. Standard has improved methods of utilizing radioactive isotopes as tracers, while Sinclair has been a partner in development of an instrument which measures the dielectric constant of liquids in a line.

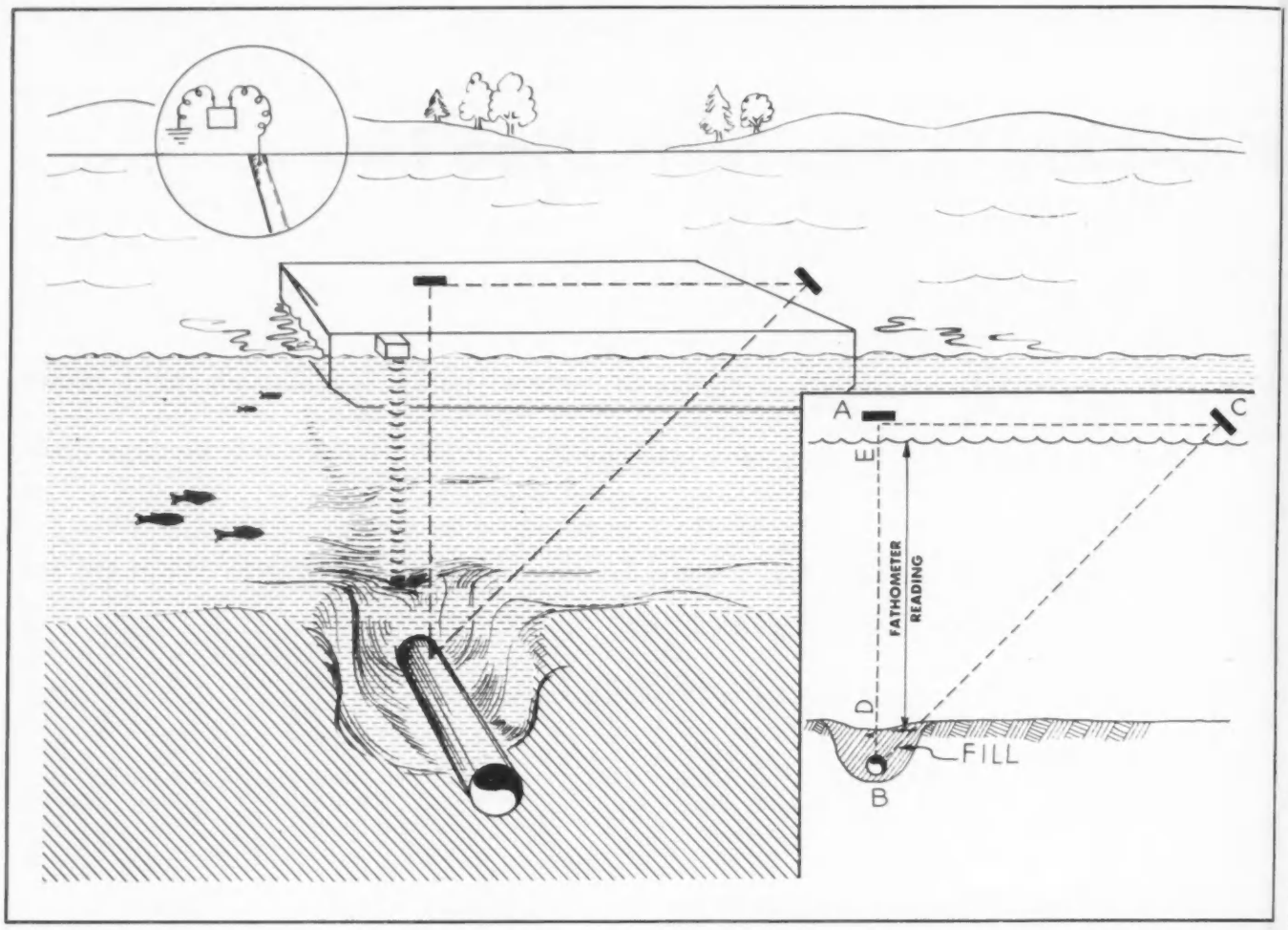
Automatic controls: Plantation, Standard of California, Phillips Pipe Line Company, Sunray Oil Corporation and Shell Oil Company, each in a different way, have further developed labor saving devices in automatic stations and remote controls.

Station construction: The Pure Oil Company has developed and installed completely new types of hydraulically-operated remote valving which shows promise of having wide usefulness. In its products line in Ohio, Pure has improved manifolding by the use of in-the-line vertical pumps to effect shorter interface cuts and reduce construction costs. The Texas Pipe Line Company is having good success with mechanically cleaned filters and built-in sumps in tanks, and is the first user of combinators or totalizers to permit a single ticket printing of several pipe line meters.

Metering: Shell Oil Company has developed a "measured mile" for calibrating meters—replacing the usual prover tank.

Mechanical product separation: Shell Oil has reduced product mixture on its 240-mile 14-inch pipe line from about 800 barrels to about 60 barrels by using sealing scrapers between products.

Remote Gauging System. The Great Lakes system receives product from numerous refineries scattered over a wide geographic area and has the most complex dispatching problem of the major pipe lines. It operates to common specifications of housebrand and premium gasolines from gauged receiving tanks scattered over three states, and unless labor means nothing, remote gauging is a "must." To meet these problems, Great Lakes has developed remote gauges and wire recordings which, in voice from magnetic tapes, communicate on command the gauged height in any tank. Since the report is a voice report, it can be put on any sort of wire, and the distance from point of measurement to point of use is important. The units are made in assemblies so that service and repair is accomplished by unit replacement and specialists at each point are not required. These facilities greatly facilitate putting together common streams in proper proportions at line junction points. In terminals, in order to speed up truck loading in multiple compartment trucks, electronic counter mechanisms and gang switches permit as many as three products selected at will from any of the rack components to be simultaneously loaded, counted and printed on a single truck loading



Great Lakes Pipe Line Company uses this method in determining the amount of cover on river crossings. The locator nulls out when the plane of the coil is at right angles to the pipe. By using a spirit level on the large coil, point 'A' and point 'C' can be established. Point 'A' is directly above the line, and if the coil is held at 45 degrees with the horizon at 'C,' AC will be equal to BC, which is the distance of the instrument from the pipe line. A fathometer reading shows the depth of the water; compute AD and subtract from AB to get the number of feet of cover on the line.

ticket or manifest in remotely controlled printers at a central point on the truck rack. Maximum loading time is thus limited to the time required for the largest compartment. Because these same truck racks also have a wide range of volume requirements, loading pumps are arranged in multiple units on each product line to operate in parallel and to be controlled automatically to fit the rack rate requirement. The energizing of tank valves, the starting of loading pumps and the signal to the rack that pressure is available, are all handled through a coaxial cable on which a low voltage frequency is impressed to select the sequence operation required. One coaxial cable handles the loading from as many as ten tanks, thirty power units and their associated valves. This system should be applicable and highly desirable in any multiple product tank terminal, to handle the wide ranges of loading rates required to handle one to three or four trucks loading simultaneously.

Great Lakes has also developed a satisfactory survey method for exact depth location of pipe lines under river beds, and thus able to survey not only the backfill depth over the pipe line but also the pipe line depth under the backfill. This development should be important to all who must contend with silted and scouring river crossings.

Plantation Pipe Line has a differing dispatching problem from that of Great Lakes since all of its products originate either from terminal or refinery tanks at Baton Rouge. However, these products are distributed to individual company or batch specification over a 1200 mile system requiring delivery into literally scores of different terminals. It handles measurement problems entirely by meters and is therefore dependent upon meter accuracies for both dispatching data and line balance and loss figures. In consequence, its developments have been along the line of improving meter operations, principally, through improving the quality of the metered stream. One significant development is use of new types of self-cleaning strainers. Good results are reported both from modification of the original hay tank filters and more recent development in mechanical type filtration which has self cleaning features by circulating and washing nozzles. The company is also having some success in the use of magnetic type filters which selectively hold the iron oxides which move in the line and due to their properties can be removed by magnetic separation. For safety and accuracy of control Plantation has gone over completely to the use of strain gauge instruments and electrical impulse transmission into control rooms. This eliminates the leakage and mainte-

nance problems imposed by liquid control lines to the control room, with attendant fire hazards. The cost of such equipment is relatively nominal, replacement can be made easily and since all equipment is explosion proof, one serious source of danger is eliminated. Plantation also has done a great deal of work on mechanical seals and in many cases has seals which under operating pressures of 500-1000 pounds have operated 8000-10,000 hours without failure. The use of mechanical seals in pumps designed for their application promises comparatively trouble-free operation and again eliminates the hazards of fluid leakage in pump rooms.

Removing Scale. Magnolia, Plantation and Shell have done development and experimental work on magnetic filters for removal of pipe line scale. Magnolia's and Plantation's work was done with electro magnets, Shell's with permanent magnets of aluminum-nickel-cobalt alloy. This would seem to be fruitful ground for further research but its utility may be clouded by the fact that other developments may make the separation of pipe line scale less important for several reasons. Inhibitors and dehydration have decreased scale movement in properly operated products lines to minuscule amounts, and better meters and pump wearing rings are now able to handle the small amounts of scale with little or no damage to equipment. Some of the newer meters use plain sleeve bearings of materials hard enough to handle normal pipe line seals without suffering, and the operation of large size meters up to 10-20,000,000 barrels of throughput without repair attention is foreseen.

Distinguishing Products. Standard of California operates a long line from Utah into Washington state. Conventional methods of handling product interfaces seemed difficult to accomplish on this line, but Standard has developed satisfactory methods of identifying batch heads by the use of short life radioactive isotopes used as tracers in the product stream. The operation is safe for personnel and no difficulties are reported either in handling material or accuracy of results.

Sinclair and Nelson Electric Company have jointly developed an instrument which measures the dielectric constant of liquids in a pipe line. Readings are instantaneous and can be calibrated so that they correlate fairly closely with gravity of the passing stream. Trans-Northern Pipe Line Company in Canada is installing these instruments for switch cutting, using them instead of the conventional gravitymeter. If these instruments will differentiate between two liquids having different compositions but the same gravity, they will be a useful adjunct in cutting between gasolines or oils of closely similar gravity specifications.

Sohio Pipe Line has a small but complex system in the old Ohio Emergency Pipe Line and the Inland system, the latter being a joint operation with Shell. At Sohio's Fostoria station, at the junction of lines from Toledo, Lima and Akron, there is a difficult problem in matching stream rates which differ in each of the three lines, all three of which pump in both directions. Their solution was in the installation of two 40,000 barrel tanks which operate as "put and take" or relay storage. The main physical features are floating roofs, cone and sump bottoms, remote low level alarms, remote precision manometer indexing of the last six-inch level of liquid and completely remote gauging of tanks and control of tank booster pumps. All the features combine to permit the tanks to be used as float tanks either filling or emptying, put and take storage at full stream rates, and complete emptying of tanks so that they may be immediately rotated from one product to another all with minimum requirements for attending labor.

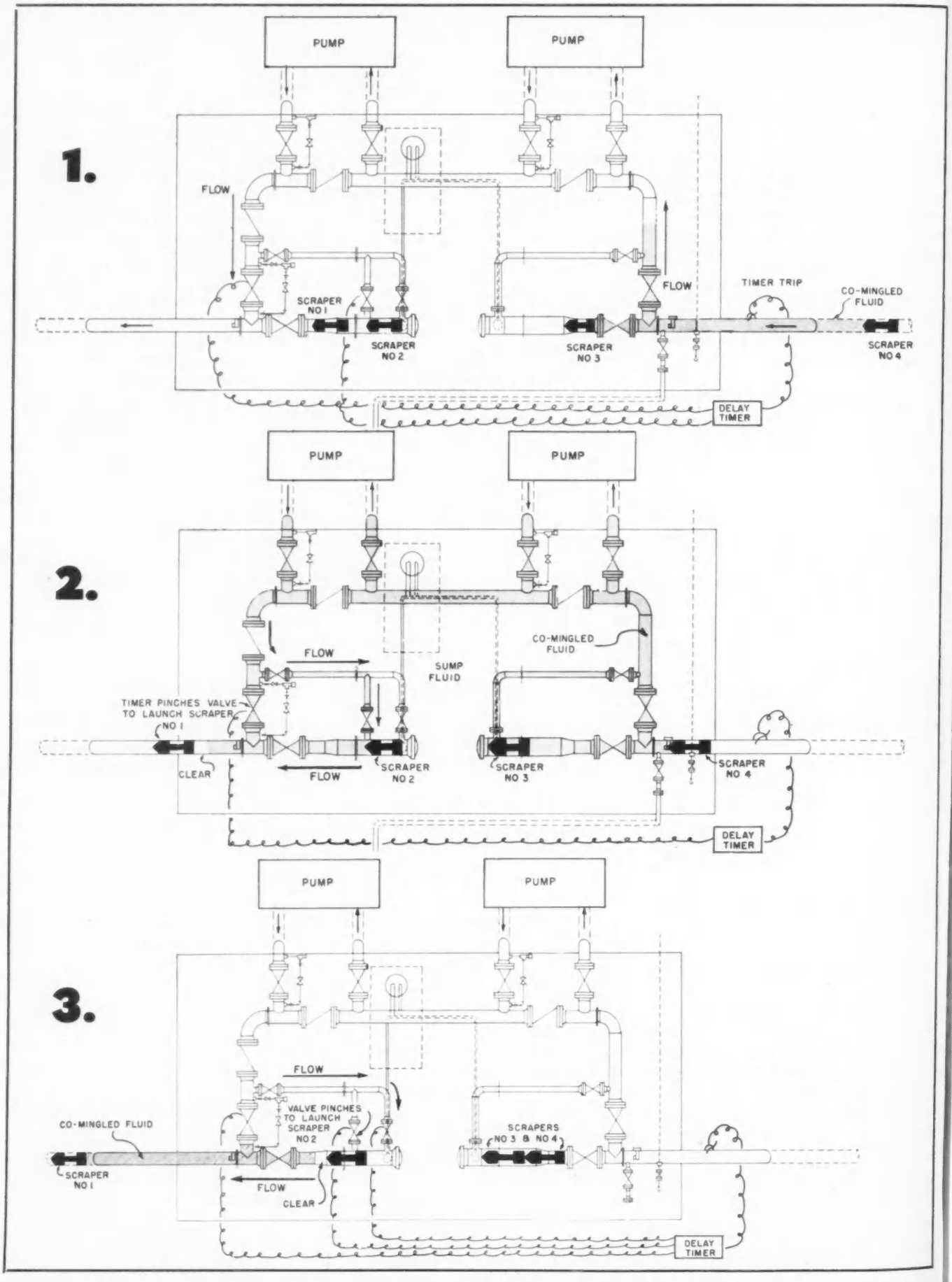
Controls. Phillips Petroleum, after installation of dehydration equipment on one line, has been able to eliminate completely the use of scrapers while at the same time C factors are continuing to improve. There is now one completely automatic and unmanned electric station in which a combination of flow rate determined by positive meter and line pressures are used for control. The operation of this station has encouraged the building of a second one now under construction. Phillips has also rebuilt old three- and four-stage pumps to make them all mechanically sealed and reports excellent operation of more than 40 units so equipped.

The Texas Company reports similar progress to that previously credited to Plantation in the use of improved back washed filters for scale removal. Texas Company in connection with Smith Meter Company developed an adding counter or combinator which makes possible the parallel operation of several meters which combine their registration into one ticket printing head so that one run ticket accounts for the whole stream throughput. With this same equipment, it is also possible to combine two printers so that the same meters can handle the tickets across a flying switch from product to product, tank to tank or company to company delivery. Texas Company also has gone over to cone and sump bottom tanks, in their case combining with the pan type roof to give an economic conservation roof which can be rotated from product to product without cleaning.

Standard of Indiana has developed a continuously recording nephelometer to monitor the condition of product stream as it leaves the dehydrating plant. The instrument operates by measuring the amount of light scatter when a beam of light is passed through the flowing sample. Since the instrument references to the source light and measure the diminished value of transmitted light, as a proportion of the original light, it is automatically compensated for changes in voltage of the light source. Changes of color of product have negligible effect on the accuracy of the unit, but water droplets or haze do. Thus in Standard's use of the unit where it is installed downstream from the dehydration plant, it operates to close degree of accuracy. If it be used in a wet stream, perhaps in a line not dehydrated, continuous addition of alcohol to the slip stream to the instrument would be necessary to eliminate the effects of water.

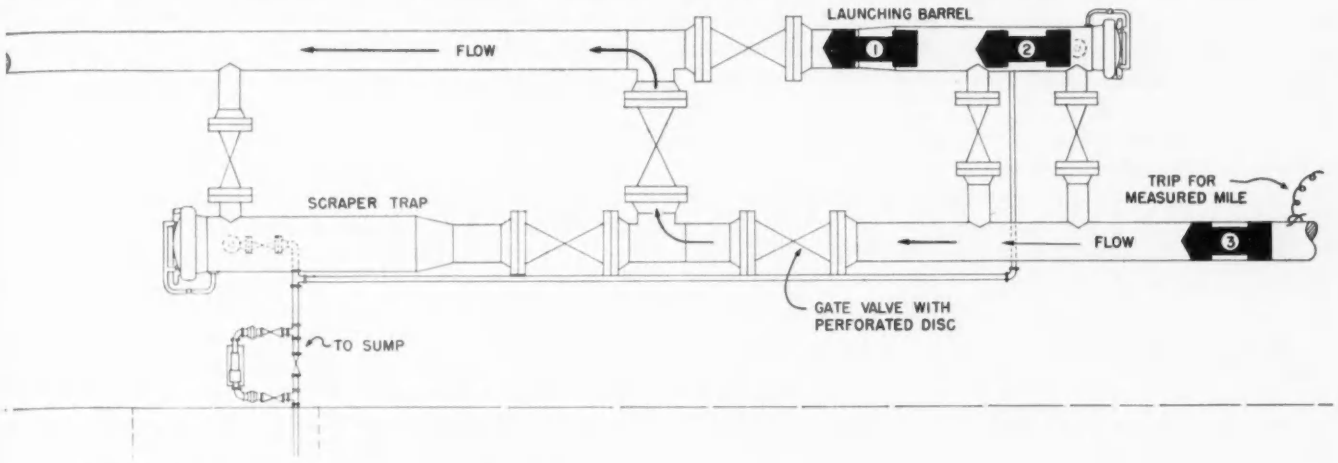
In the new 14-inch Shell line from Wood River to Chicago, it is necessary to separate some of the more critical specification materials by mechanical means to keep down volume of indisposable mixtures.

It is proposed to do this by the use of specially designed sealing scrapers which have been used successfully on an experimental basis in 8-inch and 10-inch lines. There will be automatic dispatching of these through the intermediate stations where they must be removed and inserted in such

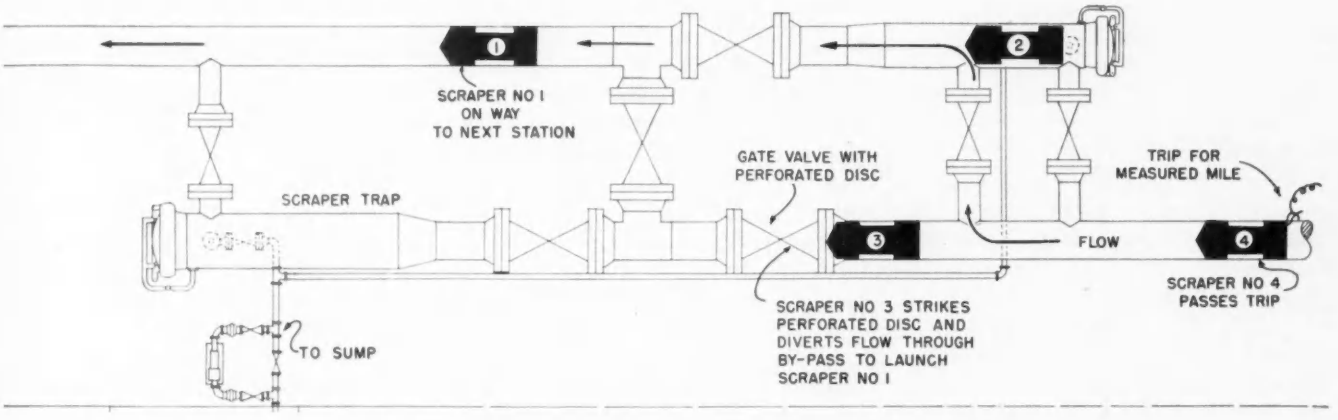


Here's how scrapers used in products separation are launched at station. Note that the volume of co-mingled fluid is slightly increased.

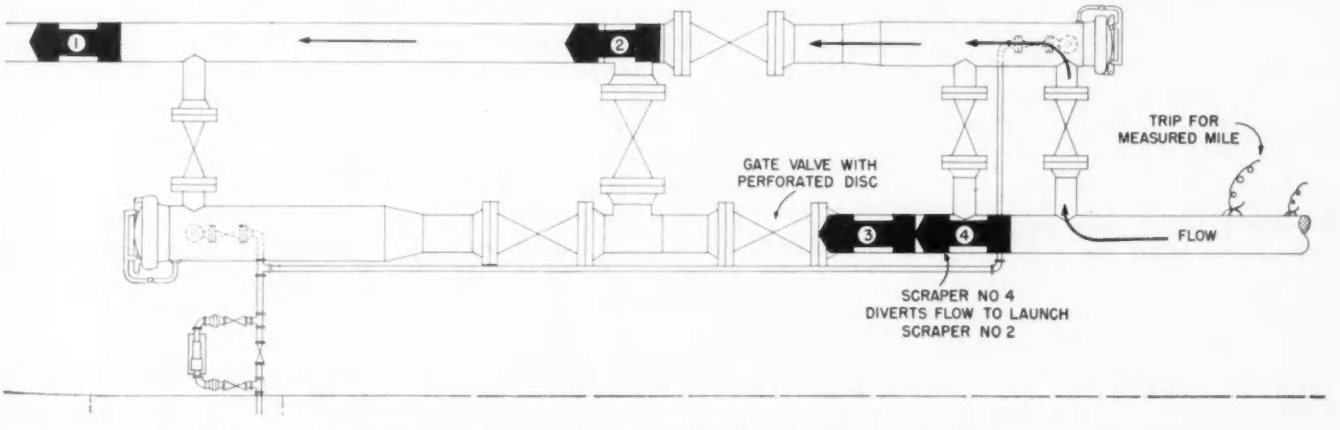
Here's how scrapers are launched at the end of the "Measured Mile"



1. Scrapers 1 and 2 are spotted in the barrel ready for launching.


SCRAPER NO 1 ON WAY TO NEXT STATION
GATE VALVE WITH PERFORATED DISC
TRIP FOR MEASURED MILE
SCRAPER TRAP
FLOW
SCRAPER NO 4 PASSES TRIP
SCRAPER NO 3 STRIKES PERFORATED DISC AND DIVERTS FLOW THROUGH BY-PASS TO LAUNCH SCRAPER NO 1
TO SUMP

2. Incoming Scraper No. 3 strikes perforated disc of gate valve to divert flow through by-pass to launch Scraper No. 1.



3. Scraper No. 4 strikes Scraper No. 3, pinching the first by-pass and diverting flow to launch Scraper No. 2.

At the end of the measured mile—that section of 14-inch pipe line which Shell used to calibrate meters instead of conventional calibration tanks—designers provided this ingenious means of automatically launching two scrapers which would maintain specific spacing to separate products and enclose commingled fluids. Note that the incoming scrapers divert flow in such a manner as to launch the scrapers in the barrel at proper intervals.

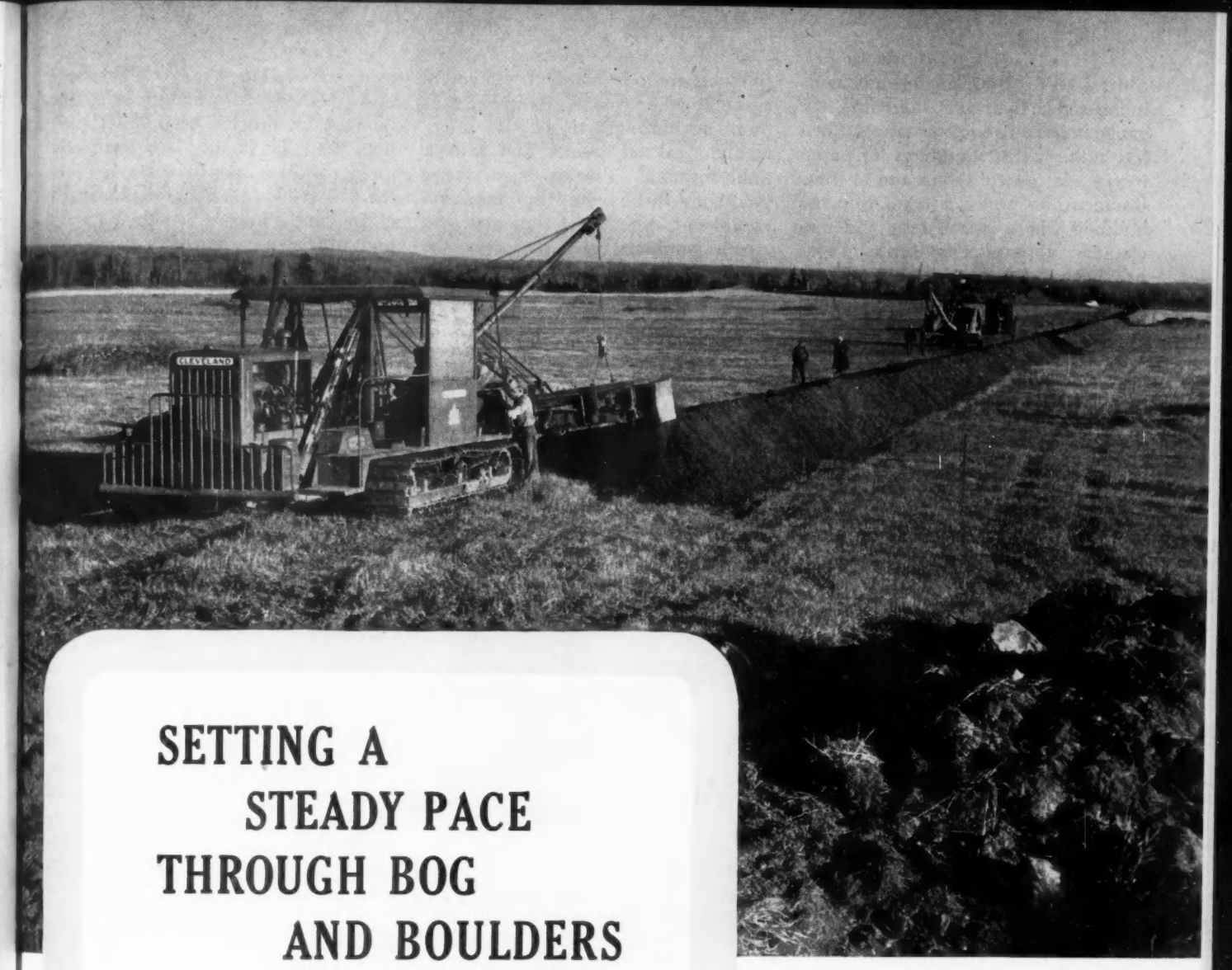
During ordinary operations where scrapers are not required to separate products, only one scraper makes the calibration run. It trips a switch hooked into the meter, starting the calibration. At the end of the so-called mile, the scraper trips another switch, ending calibration. By spotting a trap near the end of the measured mile, designers could keep the scraper from traveling all the way to the next station. This in turn called for this installation, which can launch scrapers automatically when they are used for products separation.

a manner as to confine the mixtures which take place in passing through the stations. In this operation, the mixtures will be confined between two scrapers and approximately ten barrels will be added to the mixture at each station. The arrival of the first scraper will operate a mechanical trip and microswitch which initiates a time sequence and in turn dispatches the front scraper by automatically opening the proper scraper trap valve. The arrival of the second scraper actuates the same trip but in this instance operates a longer time sequence to permit the lengthening of the space between scrapers so as to assure the proper purging of the station before sending out the second scraper. This process is repeated at each primary station where the scrapers are removed and reinserted. On this line, the secondary stations do not have scraper traps and the station when shut down automatically by-passes through check valves in the main line. In these secondary stations, a scraper trip placed ahead of the station will initiate a sequence which first slows the diesel engine down to idle speed and second throttles it to nil throughput so that part of the stream goes through the station and part goes through the check valve which bypasses the station. In this manner, the station will purge itself as the scrapers hang momentarily at the check valve, but again the passage of the scraper past the station will be fully automatic. The 14-inch line itself has been welded over internal lineup clamps using copper shoes so that there are no welding icicles nor lack of concentricity of pipe at the welds to damage the scraper rubbers. Preliminary runs in the line which is just now going into operation indicate almost perfect separation of products at the scrapers with no evidence of scraper slippage in the stream. Using these methods, it is anticipated that the mixture between products will not exceed 60 barrels in a 240-mile 14-inch line and that the mixtures will be accurately confined between two scrapers and thus can be cut into small disposal tanks for reblending or other disposal. In the case of propane-butane interfaces, the mixtures will be confined to an amount small enough to permit their full utilization as fuel in heating boilers at the East Chicago terminal.

Measured Mile. In Shell's new 14-inch line, 8-inch meters with a capacity of 3000 barrels per hour each are installed, reducing the usual number of meters. This also reduces the number of calibration runs, but if conventional calibrating tank methods were used because of high meter rates, it would aggravate the disturbance of normal flows while calibrating. Whether meters are on the suction or discharge side of initial station their calibration causes either large reduction of input or requires excessively sized input boosters or main line pumps. In order to avoid all of these operating difficulties, the calibration of the Shell Wood River pipe line meters is being handled by a radically new method. Using tight scrapers sealed by soft rubber discs, the calibration is a measurement of the liquid required to displace the line through approximately a mile of 14-inch pipe holding about 1000 barrels. This section of pipe is carefully premeasured using piston packed meters and the measurement of the normal calibration run is automatic after dispatch of the tight scraper. This is done by setting mechanical trips which are triggered by the scrapers to handle switching, electric circuits and solenoid operated clutches at the meters so that a counter is automatically enclutched and declutched to exactly record the gross barrels required to displace the scraper between the two trips. The figure so obtained is then pressure and temperature corrected to net barrels for the factor on the meter. None of the operation interrupts the normal stream or requires moving any product from the line except the fill of the scraper trap at the end of the run. Incidentally, the receiving scraper traps at the end of the measured mile will not only receive scrapers but will automatically dispatch new scrapers when the dual scraper operation is used for product separation so that attendance by operators is not necessary at the time of the scraper passing. All of the features in this operation have been tested in full scale operation and are known to be sound.

In the construction of Shell's 14-inch line from Wood River to Chicago, there has also been incorporated a component blender at the Wood River refinery. This component blender will receive seven component streams and automatically blend in the line the required proportions of the various run down streams in the refineries to get proper octane, volatility, etc., in specification gasoline. The full component blending operation incorporates the blending of the component streams plus butane plus lead plus dye plus inhibitor. All streams are metered and automatically proportioned through a blender which is expected to save all the normal refinery blending losses because no products are blended in tanks, remove all the requirements for manual valving and pumping in the refinery tank farm and constitute a much safer operation than conventional methods. These features are being incorporated both in the 14-inch line from Wood River to Chicago and the 8-inch line from Wood River to Lima. The calibration of the blend meters will again be accomplished by scraper displacement of a normal component through its blender meter by feeding it through an 800-foot loop of 8-inch pipe laid within the refinery yard with the same scraper trap features used for calibrating the main line meters, but with gang switching of the circuits to operate the clutch on each individual component meter. This permits the calibration of any component blender meter on stream at its normal running rate and without displacement of any component from its proper place in the blended stream. Thus, both product specification and accuracy of measurement are accomplished in one automatic and foolproof operation. The cost of calibration will be materially reduced and the accuracy of metering should be materially improved.

It has been interesting to see that all of the products pipe line operators seem to be concerned with the same features affecting their operations. Each company in one way or another has improved the safety of its stations from the standpoint of fire hazards and protection of control rooms against accident, fire and explosion. In reality there seem to be two schools of thought as to how to accomplish this particular feature. Plantation has solved the safety features of their control rooms by bringing electrical circuits from strain gauges into the control room instead of live product pressure lines. Shell accomplishes the same thing where engines and pump rooms are in the same building with



SETTING A STEADY PACE THROUGH BOG AND BOULDERS

This Cleveland trencher model 320, equipped with a Caterpillar D8800 Engine, is working on the 1,600-mile Lake Head pipe line near Floodwood, Minn. Let's hear what Mr. Carl C. Anderson of Anderson Bros. Corporation, Houston, Texas, has to say: "Difficult terrain makes the going rugged. This post-glacial region has a great deal of wet bog country. However, the greatest obstacle is the frequent masses of buried rock and boulders along with many tree roots. The D8800 has been performing through all this rough going without a hitch. It is very economical on fuel and oil."

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OILFIELD ENGINES

control rooms by bringing only non-inflammable hydraulic fluid into the gauge boards. In some instances, Shell has built separate buildings for pump rooms and control rooms and in these instances, no products come into the building where switch gear and mechanical apparatus is located. This has been done by the use of telemetering equipment and electrical gauging. However, in their newer stations, the less expensive route of direct force balance control actuated by hydraulic fluids has been used and Shell engineers feel that the greater simplicity of such apparatus together with improved accuracy of control and lower costs make this approach well worth while.

Automatic Controls. Another interesting feature of pipe line design nowadays is the various methods of eliminating attendants in pipe line stations. Plantation again monitors stations by remote control by microwave installation and incorporates in its system actual control from remote points. Shell did likewise in four intermediate stations on the East Line installed two years ago, but is now preparing to convert these remote control stations into fully automatic stations which will in themselves determine when they should or should not operate. In this instance, it is the writer's opinion that in the present state of development of automatic control apparatus, remote stations can operate more satisfactorily as fully automatic stations controlled simply by the pipe line stream than by depending upon either an operator or dispatcher controlling the station from a remote point. Thus, in passing, it should be mentioned that Standard of California, Phillips, Shell, Standard of Indiana, Sun Ray and perhaps others are all depending upon completely automatic stations which work either entirely unattended or with minimum caretaker attendants for the purpose of good housekeeping and maintenance. This is a far cry from the multiple unit pump station and manual operation which were conventional a few short years back.

Insofar as the writer has been able to learn, no one has yet placed dependence upon complete automatic control of product takeoff without supervisory personnel. However, there is at least one complete pipe line design not yet built in which four products are to be handled completely automatically from the point of first pumping through all of the intermediate takeoff points and into a final terminal. The intermediate points are to be served by automatic equipment which discriminates between products, and measures the products either on preset volumes or on tank gauges in tankage, entirely without personnel. All the features for such construction are now available, and again the opinion is hazarded that in the immediately foreseeable future, either stub lines to remote points or even intermediate terminals on main line systems may be so served.

Most of the power efficiencies seem to be solved. There are available several methods for maintaining the internal smoothness of product pipe lines and C factors are generally maintained on modern pipe lines in the 150-160 C factor range. Standard of Indiana, Phillips, Socony-Vacuum and others use dehydrated streams and avoid internal corrosion. Plantation, Shell, Southeastern, Pure Oil, Standard of California, Trans-Northern, Great Lakes and others use water borne nitrite inhibition. Other companies such as Keystone and Susquehanna have used chromates in one form or another for inhibition of pipe lines.

Manufacturers' Aid. This discussion would not be complete without a word of tribute to the manufacturers who have contributed so many new developments to the industry, especially:

- The meter companies, who have steadily improved their measuring equipment to such a point that 10 million-barrel runs are not exceptional,
- The metals companies who have developed surfaces which successfully stand the abrasion of moving pipe line scale in high speed equipment such as centrifugal pumps,
- The various seal manufacturers who have steadily improved their manufacture to the point where several manufacturers' seals in both single and double type are quite satisfactory,
- The manufacturers of motors, pumps and engines who have steadily increased the efficiency and reliability of their equipment to a point where many pipe lines have been unable to justify the installation of standby equipment,
- Several manufacturers of valves and gates who have succeeded in producing valves which are tight on fuel oil, kerosine and gasoline, and
- A whole list of specialty manufacturers like the various control companies and the manufacturers of servo mechanisms and switch gear, who have produced the component parts required to meet the many and complex problems of control and operation in products pipe lines.

ACKNOWLEDGEMENT

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About the Author

S. S. SMITH, manager of the Products Pipe Line division of Shell Oil Company, was born in Pittsburgh, attended high school in Parkersburg, W. Va., and was graduated in 1915 from Marietta College where he majored in mathematics and physics.

During World War I, he became a second lieutenant in the Balloon Corps; during World War II he developed a portable pipe line which was used extensively to supply the allied armies with petroleum products. For this he was awarded the government's Medal for Merit.

Before joining Shell, Smith sold pumps and compressing equipment and installed gasoline plants. In 1924 he became manager of the natural gas and natural gasoline division of Roxana Petroleum Corporation, which job he held until 1935. Then after two years as special consultant to Shell's manufacturing division he was promoted to his present position.

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Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	8⅝" to 20" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5 9/16" to 12¾" O.D.	Up to 55'	.188" to .375"	Fontana, Calif.
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A FIELD MANUAL

Pipe Line Corrosion And Cathodic Protection

Part 1 Soil Resistivity Surveys

By **MARSHALL E. PARKER,** Consultant, Houston

Soil Resistivity Units. The unit of soil resistivity is the *ohm-centimeter,* usually abbreviated *ohm-cm;* the resistivity of a given soil is numerically equal to the resistance of a cube of the soil one centimeter in dimensions, as measured from opposite faces (Figure 1.1). The resistance of a rectangular solid other than a cube is given by

$$R = \frac{\rho \times L}{W \times D}, \qquad \text{Eq. 1.1}$$

where W, L, and D are the dimensions in centimeters, as shown in Figure 1.1, and ρ is the resistivity; the unit must be ohm-cm, in order for the equation to be consistent. The resistance between any two terminals, of any size and shape, in contact with a body of soil, of any extent, is determined by the size and spacing relationships and by the resistivity of the soil. For simple cases, the resistance can be computed, but the mathematical complexities are often very great.

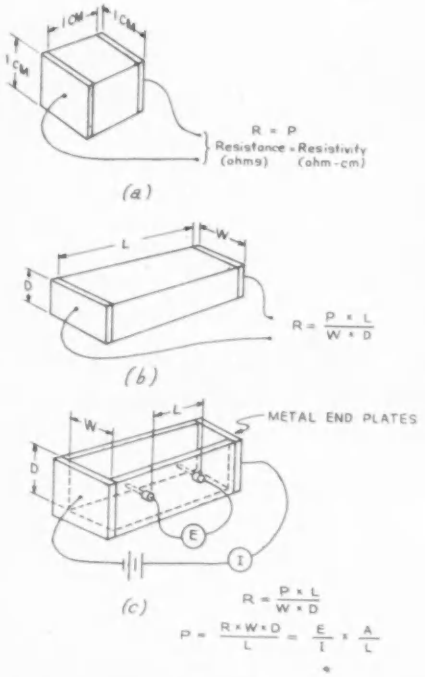

FIGURE 1.1. (a) Resistivity (ρ) in ohm-cm is numerically equal to the resistance (R) in ohms between opposite faces of a cube one cm on the side. (b) Resistance of a rectangular solid. (c) Soil box, in which ρ is obtained by measuring the resistance between the planes of the two potential pins.

Two-Terminal Resistivity Determination. An apparatus similar to that illustrated in Figure 1.1 may be used to determine the resistivity of soil samples; in corrosion investigations, however, it is much more useful to measure the soil in place.

If two terminals are placed in the soil, then it will be possible to determine its resistivity by measuring the resistance between the two electrodes. If they are placed close together, it will be necessary to maintain a known and fixed distance between them; if they are far enough apart, surprisingly enough, the indicated value is virtually independent of the distance. Either A-C or D-C may be used, and the resistance may be determined by measuring current and potential, or by a bridge circuit, in which the unknown resistance is compared to one which is within the instrument.

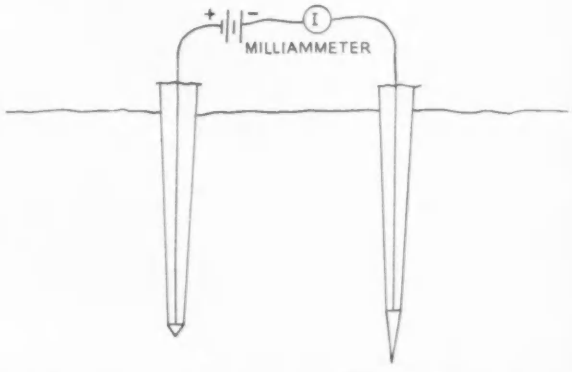

FIGURE 1.2. Shepard Canes for Soil Resistivity Measurement. Current from a three-volt battery (two flashlight cells) is passed through the soil between two iron electrodes mounted on insulating rods. Current flow is measured by a double range milliammeter (0-25 and 0-100) graduated to read directly in ohm-cm (10,000-400 and 500-100). Cathode is made larger to avoid polarization; accuracy is about 6 percent when tips are separated by eight inches or more. Meter, batteries, and switch are mounted on anode rod.

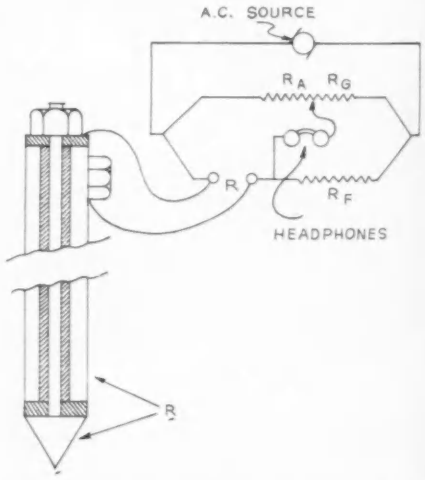

FIGURE 1.3. A-C Soil Rod. Current from an A-C source (usually a battery, buzzer, and condenser) is passed through the soil between a steel rod and an insulated steel tip. The slidewire is then adjusted until no signal is heard in the headphones; at the point of balance

$$\frac{R}{R_F} = \frac{R_A}{R_B}, \text{ or } R = R_F \frac{R_A}{R_B}$$

In practice, the slidewire R_A R_B is graduated to read R directly; then $\rho = R \times C$, where C is a constant for the particular rod, determined by calibration in a solution of known resistivity.

Figure 1.2 illustrates the Shepard Canes, which use D-C impressed between two iron electrodes. This apparatus is rapid in use, but gives the value corresponding to a small sample of soil, in the immediate neighborhood of the electrodes. Figure 1.3 shows an A-C bridge type

apparatus; this device is also very rapid in use, but it, too, measures only a small sample. Numerous variations of the latter are on the market.

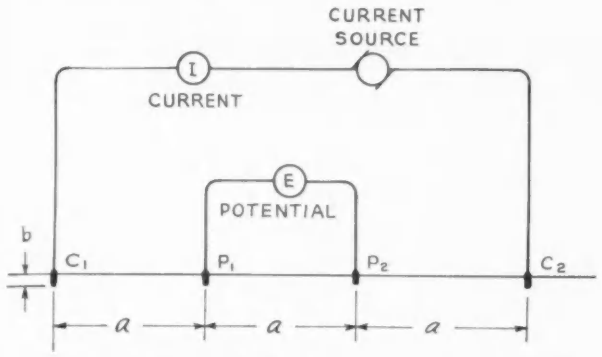

FIGURE 1.4. Four-Terminal (Wenner) Measurement of Soil Resistivity. Distance (b), depth of electrode, must be small compared to (a). The basic formula is

$$\rho = 2\pi a \frac{E}{I}$$

The resistivity is "averaged" to a depth approximately equal to the electrode spacing (a).

Four-Terminal Resitivity Determination. In order to include a larger sample of the soil, and to measure the resistivity at greater depths, the four-terminal or Wenner method may be used. The basic circuit is shown in Figure 1.4; following figures show some of the specific methods based on this technique. Details of operation vary with the particular instrument used, but the principle is common to all. It should be noted that the resistance measured is that between the two inner, or potential, electrodes; the outer pair serve to introduce the current into the soil.

The value obtained is an "average" value to a depth approximately equal to the electrode spacing; actually it is influenced to some degree by soil lying at even greater depths. There is no sharp dividing line, but the influence of soil at greater and greater depth becomes smaller and smaller.

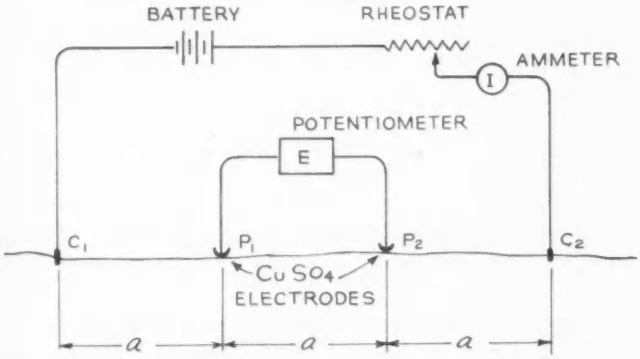

FIGURE 1.5. Ammeter-Voltmeter Measurement of Resistivity. A storage battery or dry cells may be used for current. Copper sulfate electrodes will help avoid polarization errors. The voltmeter used must be high resistance, or a potentiometer may be employed. If the distance (a) is made 5 feet, 2½ inches, then the formula simplifies to

$$\rho = 1000 \frac{E}{I}$$

Direction of current should be reversed, and readings averaged, to balance out extraneous currents or potentials in the soil.

Other Methods. There are at least three possible indirect methods of measuring soil resistivity, in which no contact is made with the soil at all. An induction type pipe locater gives an indication of the resistivity below

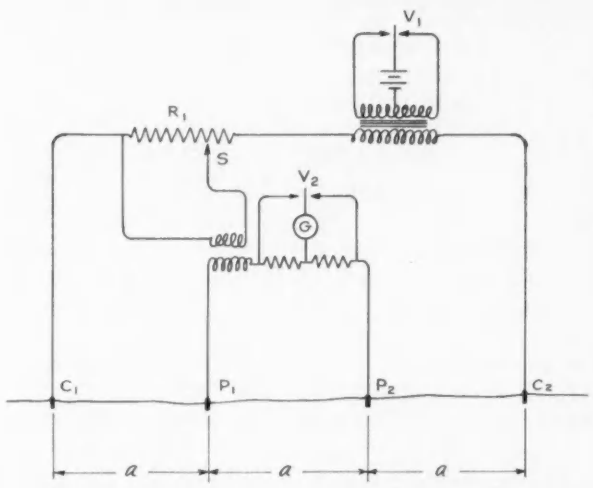

FIGURE 1.6. Vibroground (Simplified Diagram). Vibrators V_1 and V_2 are synchronized; V_1 converts the battery's D-C into A-C; the slidewire S is adjusted until the IR drop across R_1 just bucks out the current in the potential circuit, as indicated by a zero deflection on the galvanometer G; R is then read directly on the slidewire, and ρ is obtained from

$$\rho = 2\pi a R$$

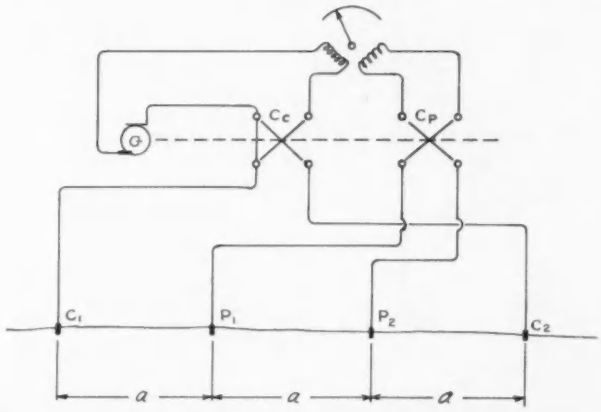

FIGURE 1.7. Soil Resistivity Megger (Simplified Diagram). D-C from the hand-cranked generator G is converted to A-C by the Commutator C_c, and enters the soil through C_1 and C_2, after passing through the current coil; the A-C potential picked up between P_1 and P_2 is converted to D-C by commutator C_p, and is fed to the potential coil. The needle comes to rest, under the opposing forces from the two coils, at a point which indicates the resistance R. ρ is then obtained from

$$\rho = 2\pi a R$$

it, and may be calibrated to yield fairly accurate results. In general, this method may be very useful in scouting out low resistivity areas, which can then be explored more precisely by one of the methods already described.

The value and phase angle of the impedance (high-frequency) between two parallel conductors lying on or parallel to the surface is a function of the soil resistivity, and thus a device could be built which would employ this principle. It is also true that the tilt of the radiation field of a remote radio transmitter at the surface of the earth is a function of the soil resistivity. Both of these methods offer some promise of development into very rapid and possibly automatic systems for the recording of resistivity, but the development has not yet been done.

Locating "Hot Spots" on Bare Lines. The full cathodic protection of a bare pipe line is rarely feasible; protection distributed at the "hot spots" can, however, be very attractive economically. These corrosive areas may be located most readily by conducting a soil resistivity survey along the route of the line, using any one of the techniques described.

Readings should be taken according to a systematic procedure; the following is suggested: (1) a reading be taken at least once every 400 feet; (2) a reading be taken at any point where there is a visible change in the soil characteristics; and (3) whenever a reading differs markedly from the preceding one, additional readings be taken to locate the point of change.

For this type of survey, readings should give values which correspond to the soil at pipe depth. This means that holes will have to be drilled or rodded for the one-rod apparatus to a depth about equal to that of pipe burial. The four-terminal system should be used with an electrode spacing of about 1½ times pipe depth; very often the 5-foot, 2½-inch spacing (which gives a multiplier of exactly 1000) will be well suited for this purpose.

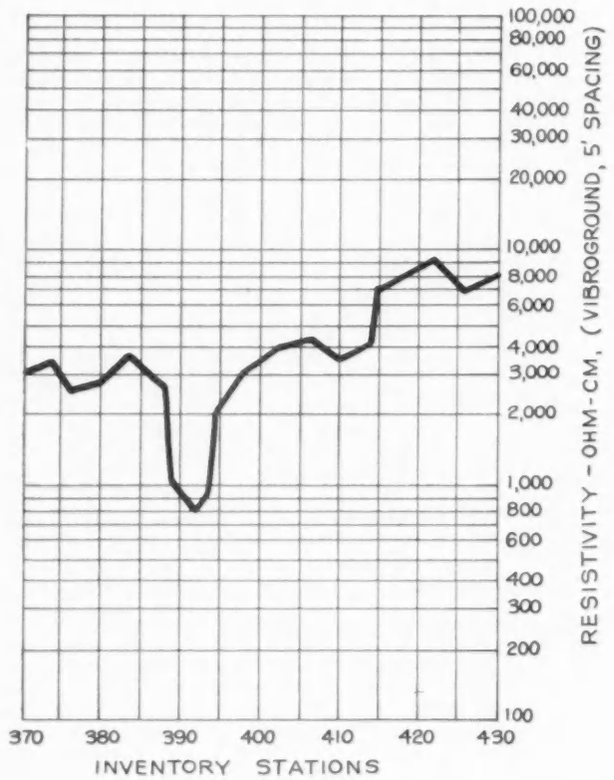

FIGURE 1.8. Soil Resistivity Profile. Measurements taken by any of the methods described are plotted as ordinates (using a logarithmic scale), with distances along the pipe line as abscissas.

Values obtained should then be plotted on a diagram representing the length of the line, as indicated in Figure 1.8. The vertical scale of resistivity is logarithmic, since resistivity ratios are of interest, rather than differences. From such a diagram the "hot spots" are readily located; the technique will be discussed more fully in a subsequent chapter.

Surveys for Ground Beds. In the installation of ground beds for cathodic protection systems, it is of primary importance to obtain low circuit resistance, to conserve power. This can be done most easily in low resistivity soil—and in this application, the resistivity to great depth is of some importance. Such a survey, then, can best be accomplished with the four-terminal method. The prospective site should be marked off into a grid system, and measurements of resistivity taken at grid intersections. It is suggested that these measurements be made with electrode spacings of three different values; 5 feet, 2½ inches, 10 feet, 5 inches, and 20 feet, 10 inches.

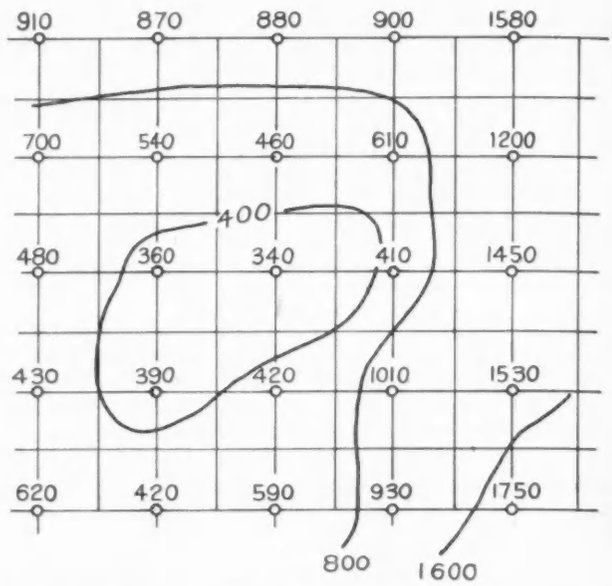

FIGURE 1.9. Resistivity Plat. Resistivity readings taken at spaced intervals, with additional readings at critical points, are indicated by the small figures. The curves represent lines of equal resistivity. Such plats are of value in locating sites for ground beds and in their design.

A diagram should then be prepared of the site and the values obtained plotted thereon. Figure 1.9 shows such a diagram, with readings indicated and "contours" drawn. By using colors, all three sets of values can be put on the same diagram, though only one is shown here. This diagram should be plotted in the field, so that additional readings may be taken if the data are confusing. A preliminary spacing of 50 feet or 100 feet is suggested; if the values vary only slightly, no greater detail will be required for the accurate design of the ground bed.

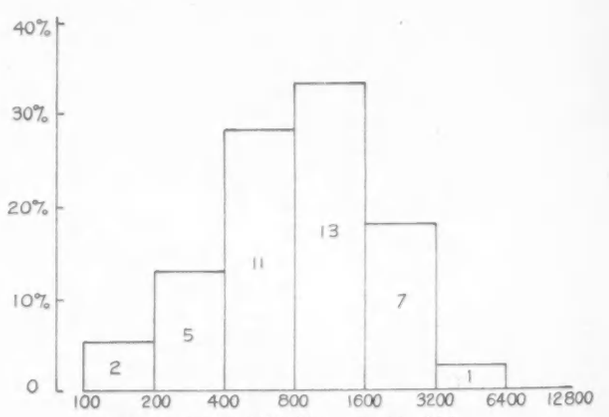

FIGURE 1.10. Resistivity Histogram. Equally spaced resistivity readings taken over an area or along a pipe line route are plotted according to the frequency of occurrence of readings in the different ranges. Note that successive ranges cover equal resistivity ratios, rather than arithmetic differences.

Area Surveys. Where the piping to be protected is a network, rather than a cross-country line, the soil survey should be made much like the ground bed survey just described, except that the spacing may be considerably greater in most instances. In addition to the area diagram or resistivity plat, it is often helpful to compile a frequency distribution or histogram of the resistivity values found, as shown in Figure 1.10; note that the divisions are logarithmic in nature; that is, each "cell" of the distribution is bounded by two values with a uniform ratio.

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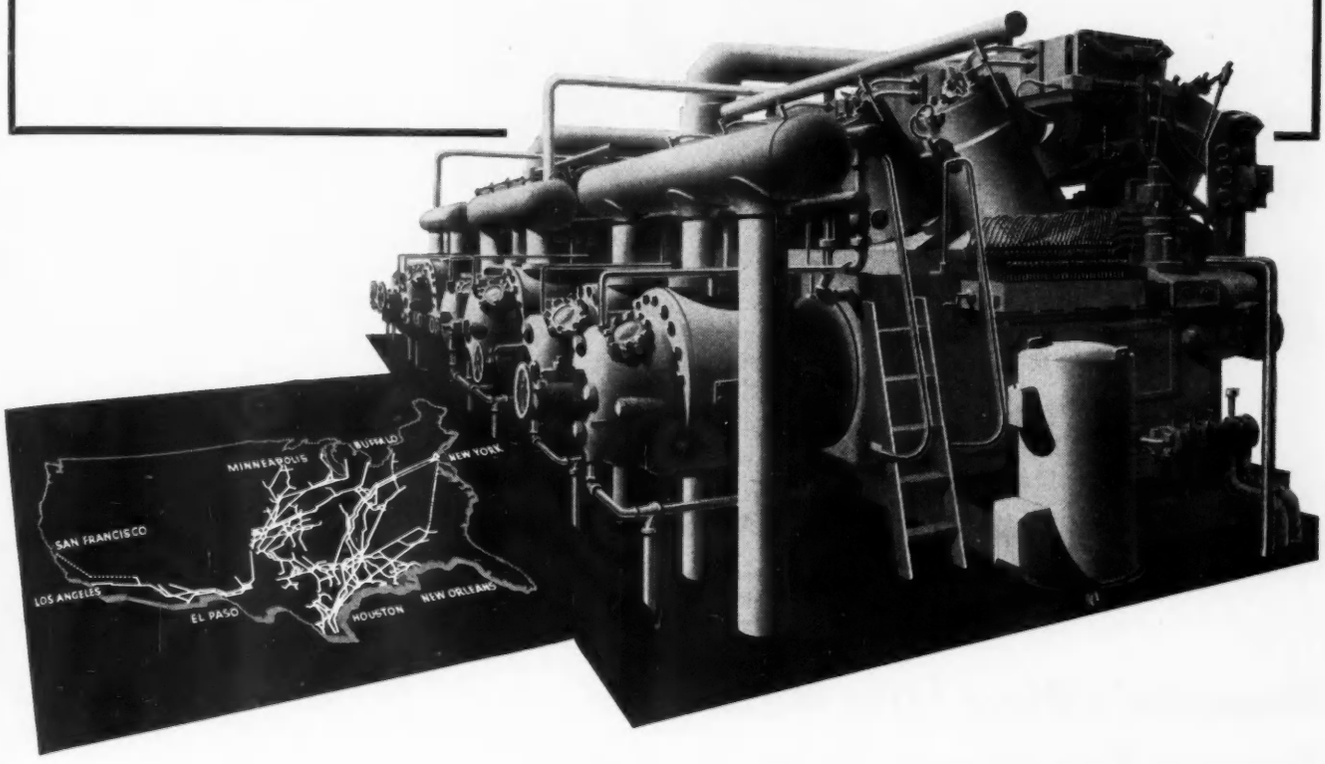

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Humble Pipe Line serves 393 producing oil fields in Texas and New Mexico. The gathering system comprises 3179 miles of pipe connecting 4883 producers' leases into which flows the production from 21,856 wells.

There are 5893 miles of trunk lines, ranging from 8 to 20 inches in diameter. Through its trunk lines the company moves 80 different grades of crude and products totaling an average of 775,000 barrels per day.

Humble Pipe Line Company, a wholly owned subsidiary of Humble Oil & Refining Company, was organized as a common carrier in March, 1919, and began its operations with acquisition of a small gathering system, known as the Southern Pipe Line Company, consisting of less than 50 miles of four-inch and smaller pipe.

The program of expansion undertaken in 1919 included a line from West Columbia to Webster and Texas City, and an eight-inch line from the Ranger field to Webster station, a distance of about 300 miles, was completed in December, 1919. Each of the six pumping stations on this line was equipped with three 10,000-barrel capacity plunger pumps driven by vertical, full diesel oil engines. This was the first long pipe line to use the vertical diesel in driving oil pumps.

The first ten years saw the company extend its facilities to distant points throughout Texas and into New Mexico, covering a large area with its main line systems and making it possible in subsequent years to enter and serve many new fields and pools in close proximity to these trunk line arteries. By the end of 1929 Humble was operating 6200 miles of pipe line and transporting an average of 250,000 bpd.

Important projects during the period following provided an outlet for the Van field to the Louisiana state line, and enlarged the system to provide transportation for the vast production of the East Texas field, discovered in 1931.

In 1936, Humble built the first line to handle liquefied petroleum gas, a 300-mile, eight-inch line, with capacity of 20,000 bpd, from East Texas to Baytown.

With these major projects and many small gathering systems and extensions, the company was at the end of 1939 operating 7400 miles of pipe lines and transporting an average of 385,000 bpd.

The period from 1940 to the present brought heavy demands in volume of oil and products handled. Although only 1700 miles of line were laid, the volume of oil gathered and transported daily practically doubled. For example, in 1948, the largest volume year, an average of 610,000 bpd was gathered and 760,000 bpd was transported.

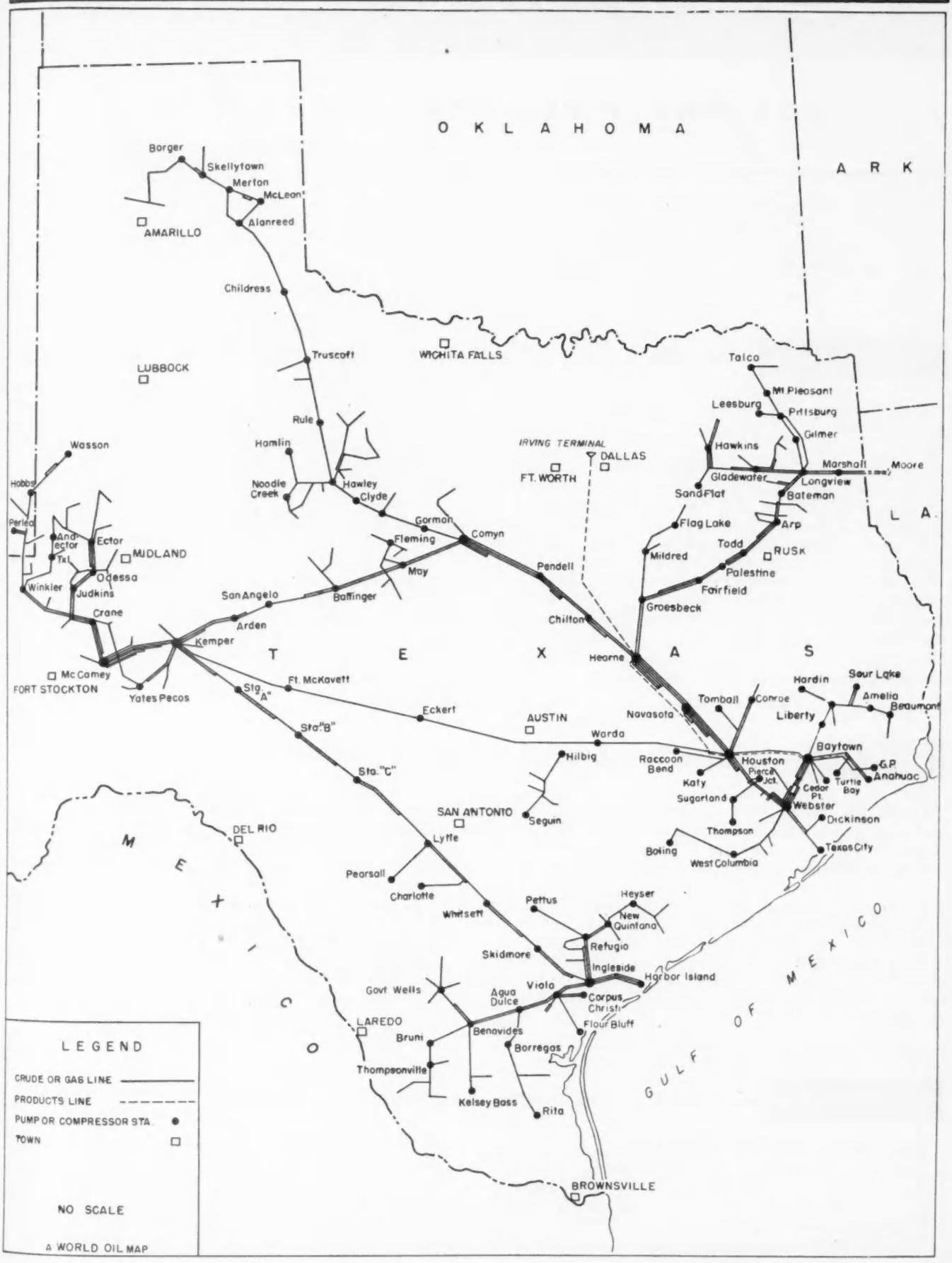
Major projects during this period included part ownership in the 300-mile Bayou system, constructed in 1943 from Baytown to Baton Rouge. Early in 1951 the company sold its interest in this line. In December, 1942, Humble Pipe Line contracted to convert an old gas line from Refugio to Houston to an oil feeder for the "Big-Inch." It went into operation in October, 1943, and ran at almost 100 percent load—80,000 bpd—until 1945, one month after V-J Day.

An eight-inch products line with 20,000 bpd capacity, extending 276 miles from Baytown to Irving, Texas, mid-way between Fort Worth and Dallas, was put into operation in 1946. The most recent major project was construction of an 18-inch line from Kemper Station in West Texas to Satsuma station near Houston, to provide increased capacity from West Texas. This line is equipped with three electric motor-driven centrifugal pumping stations with sequence control operation for nominal capacity of 135,000 bpd.

No. 3 of a Series

HUMBLE PIPE LINE COMPANY

Map of the Month



Rules of Thumb

FOR THE PIPELINER'S NOTEBOOK

These formulae from the pages of engineers' own notebooks yield rough, but reasonably accurate, answers for design, maintenance and supply questions. Use them for quick calculations to solve your everyday pipe line engineering problems — and if you have a pet "Rule of Thumb," share it with others by sending it to Don Taylor, Pipe Line Editor, WORLD OIL, P. O. Box 2608, Houston.

Engineering Design —2—How do you estimate compressor station fuel needs?

Multiply horsepower by 240 to get cubic feet of fuel per day.

Example. In case of an 11,000-horsepower compressor station which will average 10,000-horsepower in service throughout the 24-hour day, the fuel consumption will be 10,000 × 240 or 2,400,000 cubic feet per 24-hour day.

To many engineers, this figure may seem high. It is based on a factor of 10 cubic feet of gas per horsepower hour. And many two-cycle engines running under full load can shave this figure to less than 9 cubic feet per horsepower hour. Yet it must be remembered that a two-cycle engine loses efficiency when the load falls off. As a matter of fact, the engines must be 95 percent loaded to maintain high efficiency.

Since most stations have at least one engine not under full load, the average gas consumption for the entire station must be higher than that of a single engine. Also adding to the basic fuel requirements is the amount of gas which is used in generating auxiliary power.

For an over-all figure, 10 cubic feet of gas per horsepower hour or 240 cubic feet of gas per horsepower day is fairly accurate.

In case of the gas turbine and the steam powered compressor stations which are coming into use on gas transmission systems, fuel consumption will be slightly higher. For instance, the gas turbine will use about 10.5 cubic feet of gas per horsepower hour. And it would be safe to estimate that a turbine station would use about 11 cubic feet per horsepower day.

Miscellaneous —2—How fast does oil move in a pipe line?

Divide the throughput, in barrels per day, by the square of the nominal diameter, in inches; divide this result by 100; and subtract 1 from the answer. The answer is the speed of the oil column in miles per hour.

Example: A 12-inch line has a throughput of 70,000 bpd; 70,000 ÷ 144 = 486; 486 ÷ 100 = 4.86; 4.86 — 1.00 = 3.86. The oil moves about 4 miles per hour.

This rule is rough, but seldom is an accurate answer needed for this problem. Greater accuracy can be had by using the true inside diameter of the line in the following formula:

$V = 0.0081 \times Q/d^2$, where V = speed, mph, Q = throughput, bpd, and d = inside diameter of pipe, inches.

Take the above example: If the wall thickness of the pipe is ⅜ inch $V = (0.0081)\ (70{,}000 \div 144)$ V = 3.94 or about 4 miles per hour.

Example: A 20-inch pipe line has a throughput of 200,000 barrels per day. How fast does the oil move inside the pipe line?

By the first method: 200,000 ÷ 400 = 500; 500 ÷ 100 —1 = 4 miles per hour.

By the second method: $V = (.0081)\ (200{,}000 \div 19.25^2)$ V = 4.37 or about 4 miles per hour.

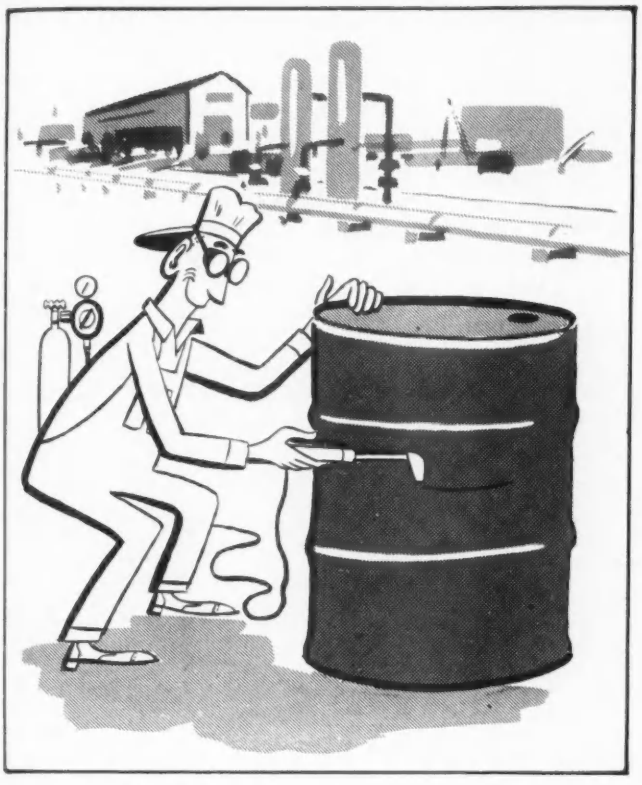
Corrosion Protection —3—How can output of magnesium anodes be predicted?

For a single 17-pound magnesium anode, working against a fully protected pipe, divide the soil resistivity in ohm-cm units into 180,000; the answer is the current output in milliamperes.

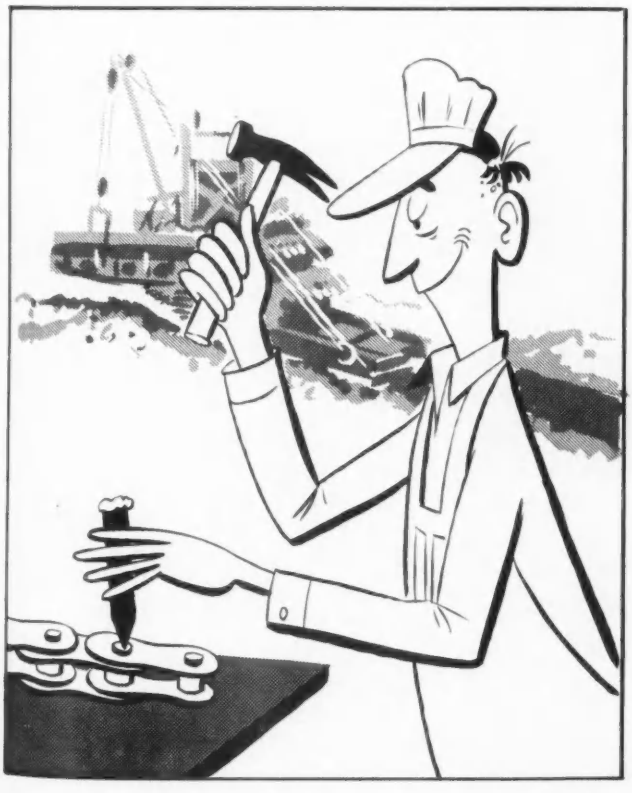
Example: Soil resistivity 3200 ohm-cm; 180,000/3200 = 56.25; current output will be about 56 milliamperes.

The rule works for *single* anodes against fully protected pipe; anode groups will have lower current output per anode, and if the pipe is not fully protected, the current output will be greater. For 32-pound anodes use 195,000; for 50-pound anodes use 204,000.

Perils of Pipeline Pete



An old drum makes a fine barbecue pit—IF you remember to steam out the vapors. Poor Pete didn't. Vrrroom!



Here's how Pete learned to use a soft headed hammer when working on hardened high carbon steel.

Pipe Line Men in the News

OFFICERS AND DIRECTORS of Trans Mountain Oil Pipe Line Company, at a meeting in Edmonton, received details of the first season's progress on construction of the 24-inch, 711-mile line from Edmonton to Vancouver. Shown, left to right, are S. M. Blair, Toronto, vice president; W. M. V. Ash, director and president of Shell Oil Company of Canada; H. H. Anderson, Vancouver, vice president and general manager; W. J. Wilkins, director and executive member of Gulf Oil Corporation; R. L. Bridges, San Francisco, president; S. D. Bechtel, chairman of the board for Trans Mountain and president of Bechtel Corporation; W. P. Taylor, director and an executive of Union Oil Co. of California; J. K. Jamieson, Toronto, director and also director of Imperial Oil Ltd., and R. F. Bruce Taylor, treasurer.

James T. Noel

John T. Osborn

Platte Pipe Line Announces Two Executive Appointments

Platte Pipe line Company has appointed James T. Noel to head the Accounting department as chief accountant, and John T. Osborn to direct the Treasury department as assistant treasurer. Both were formerly in Tulsa, and will now be headquartered in Kansas City.

Phil K. Johnson has been named superintendent of Platte's Tax, Right-of-Way and Claims department. For the past four years, Johnson has been tax commissioner and budget director for the State of Nebraska.

Noel is a graduate of Oklahoma A. & M. College, a certified public accountant, and has been with Service Pipe Line Company, Deep Rock Oil Corporation, and Arthur Young & Company.

Osborn is an engineering graduate of Oklahoma A. & M., and took graduate work in business administration at Tulsa University. He has previously worked for Service Pipe Line Company, Public Service Company of Oklahoma, and Continental Oil Company.

Texas Pipeliners Receive Executive Secretary Posts

W. L. Walker has been elected secretary of The Texas Pipe Line Company and Texas-New Mexico Pipe Line Company. Walker entered the service of The Texas Pipe Line Company on January 21, 1920, as a stenographer-clerk and after serving in various assignments was elected assistant secretary on June 10, 1939.

B. E. Strode has been elected assistant secretary of the two pipe line companies. Strode entered the service of The Texas Pipe Line Company on February 19, 1922, as a clerk and served in the capacity of accountant and assistant to management prior to his election as assistant secretary.

R. G. Rice

Curtis M. Smith

T-G-T Men Are Elevated to New Vice Presidential Posts

R. G. Rice, vice president of Tennessee Gas Transmission Company, has been designated executive vice president. Company President Gardiner Symonds also announced the election of Curtis M. Smith, director of industrial relations, as a vice president, and James E. Ivins, formerly assistant secretary, as secretary of Tennessee Gas and its subsidiary and associate companies. W. D. Walser, formerly secretary, has been chosen controller.

Rice has been with T-G-T since it was formed in 1943, and has been a vice president since 1945 and senior vice president for the past year. He also serves as president of Tennessee Production Company.

Smith, who has been with T-G-T since 1944, has been director of industrial relations since 1950 and prior to that was personnel director.

Walser has been with the company since 1945 and secretary since 1947. Ivins joined the company in 1949.

Carl Whitaker

Tod Pazdral

Experienced Pipeliners Form Construction Organization

Tod Pazdral and Carl Whitaker have organized a new company in Houston, to construct pipe lines, river crossings, gathering systems and stations. Pazdral and Whitaker Construction Company will also offer a complete inspection service.

Pazdral is the former superintendent of Samuel L. Gallucci and Sons Company, a New York pipe line construction firm, and Whitaker was Transcontinental Gas Pipe Line Company's assistant construction superintendent.

Both men were formerly with Lone Star Gas Company and Tennessee Gas Transmission Company. Pazdral was pipe line construction superintendent of Fish Construction Company, and Whitaker held a similar position with Massey Construction Company.

Buckeye Advances Two

The Buckeye Pipe Line Company has elected Robert G. Bushnell a vice president and appointed Arthur J. Helmbrecht assistant to the president.

PIPE LINE *Construction*

By **MARION DENNARD,** WORLD OIL Staff

Proposed Line Will Connect Nebraska Pools With Platte

Western Nebraska and neighboring oil pools will be linked to the new, large diameter Platte Pipe Line through a proposed pipe line planned by Pure Transportation Company, subsidiary of The Pure Oil Company. Announcement of the project was made by Kenneth A. Covell, Pure Oil vice president, following the filing of an application with the Nebraska Railway Commission.

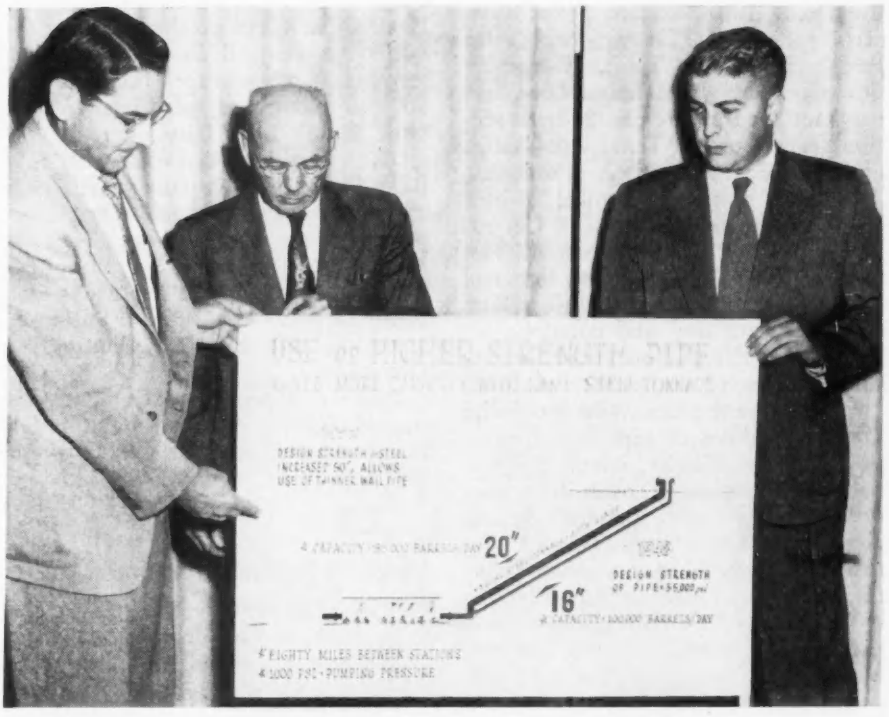
Preliminary construction schedules call for the 8-inch, 45 mile pipe line to go in early this year. The line will originate in Kimball, Neb., and it will serve the South Kimball pool, which is 12 miles south of Kimball, the Enders, Goodwin and southwest Potter pools, as well as other neighboring pools.

The new line will have a daily capacity of 25,000 barrels, and it will move south of Potter to Gurley, Neb., where crude will enter the Platte Pipe Line, in which The Pure Oil Company is a shipper and shareholder.

Chicago Area Line Will Have 35-Mile Big-Inch Extension

Chicago District Pipeline Company, Joliet, Ill., plans to construct approximately 35 miles of natural gas transmission lines in the Chicago area, and has filed application with FPC.

The $5½ million construction program would include about 3.4 miles of 36-inch pipe extending from a connection with a line to be built by Peoples Gas Light and Coke Company at a point on the Chicago city limits southwesterly to the east bank of the Des Plaines River. Also planned are approximately .3 mile of 24-inch submerged pipe line across the Des Plaines River; and about 31.2 miles of 30-inch line from the west bank of the Des Plaines to a connection with the company's existing system in Will County, Illinois. Chicago District also proposes to abandon about 3.7 miles of existing lines.



INNOVATIONS in the realm of petroleum transportation were probed at a recent meeting of the transportation subcommittee for the Hall of Science at the May 14-23 International Petroleum Exposition. Research factors concerning one prospective exhibit are shown as presented by E. J. Wacker, Jr., assistant chief engineer, Magnolia Pipe Line Company, Dallas; S. L. Westlake, center, Magnolia chief engineer, also of Dallas, and Charles Lester, chief engineer for Mid-Valley Pipe Line Company, Longview. The subcommittee, headed by J. R. Polston, vice president, Service Pipe Line Company, Tulsa, will select exhibits exemplifying progress made in the transportation division in the five years since the last oil show was held. Other members of the subcommittee include Charles Keane, chief engineer, Great Lakes Pipe Line Company, Kansas City; K. T. Feldman, chief engineer, Sinclair Pipe Line Company, Independence, Kansas; J. M. Bradley, division manager, Interstate Pipe Line Company, Tulsa; R. W. Phillips, assistant general manager, Texas Empire Pipe Line Company and Kaw Pipe Line Company, Tulsa; and H. T. Chilton, senior engineer, Service Pipe Line Company, Tulsa.

Eastern Products Pipe Line Slated for Early Completion

The first leg of Buckeye Pipe Line Company's products system extending from Linden, N. J., to Allentown, Penn., is expected to be complete early in February. This section, consisting of 16-inch pipe, will move products for a number of oil companies in Linden, one of the largest refining centers on the East Coast, to Allentown.

Near Allentown, the Buckeye line will join Tuscarora Pipe Line Company's line for trans-shipment to terminals west of Allentown through Harrisburg as far as Pittsburgh.

Proposed extensions of the system include an eight-inch line from the Marcus Hook, Penn., area to Allentown; a 12-inch line from Allentown north through the Scranton-Wilkes-Barre area to Binghamton, Syracuse and Osewego, N. Y.; and an eight-inch line from Auburn to Rochester, N. Y.

Total mileage of the system will be about 430 miles. Initial capacity out of Linden will be about 80,000 barrels a day, and out of Marcus Hook about 28,000 barrels daily.

H. L. Gentry Construction Company, Jackson, Mich., was contractor on the Linden-to-Allentown job.

315-Mile Texas-Louisiana Line Under Construction

Contracts for two sections have been let and work has been started on construction of a 315-mile natural gas transmission line in Texas and Louisiana for Texas Eastern Transmission Corporation, Shreveport, and Wilcox Trend Gathering System, Inc., of Dallas.

The new line will run from Provident City field, Lavaca County, on the Texas Gulf Coast, to Texas Eastern's system at Castor, Bienville Parish, Louisiana. Trojan Construction Company, Oklahoma City, has contract for the 80-mile, 24-inch section from Center, Texas, to Castor, and Williams Brothers Company, Tulsa, will build the 80-mile, 24-inch leg from Corrigan, Texas, to Center. Estimated cost of the Texas Eastern project is $23,283,540. The line will have a capacity of up to 140 million cubic feet per day and could be increased to 350 million cubic feet by the addition of compressor stations.

FPC has authorized Wilcox to build about 157 miles of pipe line from a point in the Hagist Ranch field in McMullen County, Texas, to a connection with Texas Eastern's system near Provident City, Texas. This project, estimated to cost about $10½ million, also includes about 60 miles of laterals, a 2200 horsepower compressor station, and metering and regulating facilities. H. B. Zachry Company, San Antonio, has contract for 30 miles of 16-inch from Yoakum to Provident City, Texas.

Texas Eastern will purchase about 100 Mmcf of gas per day from Wilcox, for transportation with other gas purchased in the area through the proposed new line.

Work Starts on Loop Lines For Southern Natural Gas

Houston Contracting Company is scheduled to start work March 1 on 525 miles of 14-, 16-, 20- and 24-inch natural gas loop lines in Georgia, Mississippi, and Louisiana for Southern Natural Gas Company.

The section under contract to Houston Contracting Company is part of a $3½ million project authorized by FPC to bring natural gas from 12 fields in southern Louisiana and southern Mississippi. The additions are being built in Louisiana, Mississippi, Alabama, Georgia and South Carolina.

The remaining 310 miles of loop lines are being built by H. C. Price Construction Company.

Engineers Ltd. Completes Leg of Pioneer Pipe Line

Engineers Ltd. Pipe Line Company has completed construction of a 150-mile section of eight-inch products line for Pioneer Pipe Line Company. The leg from Evanston to Rawlins, Wyo., is part of Pioneer's 310-mile carrier which will extend from Sinclair, Wyo., to Salt Lake City.

Initial carrying capacity of the completed line will be 12,000 barrels daily and it is estimated that about 100,000 barrels of products will be required for line fill alone. A products terminal and storage facilities for 500,000 barrels of products will be built at Salt Lake City.

The new line will tie in with Salt Lake Pipe Line Company's line which extends from Salt Lake City to a point on the Columbia River in Washington.

Other construction contracts are being carried out by R. H. Fulton & Company and Simpson Contracting Company.

Pioneer Pipe Line Company is owned jointly by Continental Oil Company and Sinclair Oil Corporation.

Wichita Falls-Oklahoma City Crude Pipe Line Completed

Continental Oil Company has completed and put into preliminary operation its new 127-mile, 12-inch crude line from Wichita Falls, in North Texas, to its Oklahoma City terminal. R. H. Fulton & Company, Lubbock, Texas, was builder.

Built to handle 53,000 barrels a day of high-gravity crude, the line crosses the Red River to give southwestern Oklahoma and Golden Trend areas a new outlet.

Further construction planned by Continental will include 18 miles of 12-inch pipe to be looped off the Oklahoma City to Ponca City line, roughly from Perry to Tonkawa, Okla.

Two New Lines Being Built

Work is under way by R. H. Fulton & Company crews on two Northern Natural Gas Company projects. Fulton is building approximately 100 miles of 26-inch in four loops in Kansas and Nebraska, and 45 miles of 26-inch loop near Beatrice Station, Nebraska.

G. G. Griffis Construction Company has completed 14 miles of 24- and 26-inch in Dakota County, Minnesota, for Northern Natural.

Salt Lake City to Boise Products Line Operating

Products are now moving through the recently-completed 330-mile line from Salt Lake City to Boise, Idaho. The $8 million eight-inch line was built by Salt Lake Pipe Line Company, a subsidiary of Standard Oil Company of California, parallel to an existing line.

Completion of the new line boosted transportation capacity from 22,000 barrels to 39,500 barrels daily. With the addition of supplementary pump stations it would be possible to increase the route's carrying capacity to 45,000 barrels daily.

The new pipe line was built in less than three months. The 130-mile section from Salt Lake City to Juniper, Idaho, was built by Macco Corporation of Southern California, and the remaining 200 miles to Boise were constructed by Engineers Ltd. Pipe Line Company of San Francisco.

Texas-Ohio Natural Gas Line Awaits Federal Board Action

At month's end, there was still the glimmer of a chance that Federal Power Commission would give its approval to plans for construction of the 1406-mile Texas-Ohio Gas Company line.

After denying the Texas-Ohio application, FPC later designated the decision as tentative, instead of final, and offered the opportunity for exceptions to the decision to be filed.

The proposed Texas-Ohio $185 million line would extend from the U. S.-Mexican border in Hidalgo County, Texas, to a terminus near Lancaster, Ohio. Texas-Ohio planned to sell all of its gas to Reserve Natural Gas Corporation, a newly-formed corporation, at the Ohio terminus of the line.

Magnolia Will Build New 47-Mile West Texas Line

Magnolia Pipe Line Company plans to construct a new 47-mile crude pipe line in Andrews County, West Texas.

The line will originate in the Nolley field in northern Andrews County near the county line of Andrews and Gaines counties and extend to the new Magutex field. From there it will go south through certain blocks in the Midland farms to the southeastern corner of Andrews County. There it will connect with Magnolia's main line from the Fullerton field to Midland station.

The line will consist of 22 miles of 8-inch pipe, 11 miles of 6-inch, and 14 miles of 4-inch pipe.

Who really owns Standard?

That old bogeyman—the Tycoon of Big Business—seems still to linger in the minds of some people. Whether or not this was ever a true picture, it is certainly false today. Standard Oil Company of California, for instance, is widely held, independent. It has its own management and shareholders. It is not connected with any of the Standard companies in the East.

The actual owners of Standard Oil Company of California now number 115,942—which is 17,000 more than just two years ago. They include 283 universities and other educational institutions; 236 churches and religious organizations; 1825 small and large businesses; 159 hospitals and other medical groups; 10,876 employees of the Company, and 102,563 other individual citizens, few of whom could be called rich. The great number of our shareholders are people like your own friends and neighbors—yourself, perhaps—mechanics, clerks, farmers, white-collar men, widows, men and women who have retired. ¶ In another sense, of course, the "owners" of Standard are our customers. You *control* the Company by your choice of brands, and you *benefit* by the quality and economy of the products we sell. The only way Standard can look after the interests of its shareholders is by making sure that Standard serves *you* well.

STANDARD OIL COMPANY OF CALIFORNIA *plans ahead to serve you better*

New Jersey Transmission Line Work Is Under Way

Gragg & Haddox, Newark, N. J., have started construction work on 16.3 miles of pipe line to transport natural gas received from Texas Eastern Transmission Corporation's line to the gas works of Public Service Electric and Gas Company at Harrison and Jersey City, N. J.

The project includes 11.3 miles of 16-inch pipe line extending from a connection with Texas Eastern's system at Linden, N. J., to Harrison. From there, branch lines consisting of 2.04 miles of 12-inch pipe and 2.96 miles of ten-inch pipe go to Public Service's Harrison gas works and its West End gas works at Jersey City.

Work is expected to be completed in April.

Phillips Pipe Line Plans Two West Texas Extensions

Phillips Pipe Line Company plans to construct an extension of its West Texas crude gathering system to the new Weems area now being developed in west Yoakum County, Texas, and extending into Lea County, New Mexico.

This project, pending approval of PAD, will consist of 4½ miles of 4-inch, and 10 miles of 6-inch pipe line. The new gathering line will connect with the company's 12-inch Odessa-Borger, Texas, crude pipe line.

Phillips Pipe Line will also extend the gathering system to the Penwell field in Ector County, Texas. This job will consist of nine miles of four-inch pipe, connecting the newly-discovered Penwell-Waddill and Wrather (Fusselman) pools in the Penwell area to the Odessa-Borger crude line. The new gathering line will also connect the Penwell-Ellenburger pool to the existing Phillips gathering system.

FPC Okays Panhandle Eastern System Expansion in Illinois

Panhandle Eastern Pipe Line Company, Kansas City, has been given FPC authority to construct about 23 miles of natural gas pipe line and a 330-horsepower compression station to augment the capacity of its Peoria, Ill., lateral and other lines extending from it.

The project includes 13.2 miles of lateral loop line in Sangamon County and 10 miles of lateral line in the Lincoln, Ill., area. The new compressor station will be in Peoria County. Estimated cost of the entire program is $1,009,000.

Construction Briefs . . .

Barry Construction Company, Houston, has contract for 50 miles of eight-inch takeup between Victoria and Refugio, Texas, for **Delhi Pipe Line Company.** The job is expected to be complete by January 15, 1953.

L. E. Farley, Inc., will begin work as soon as pipe is available on 68 miles of 16-inch crude line between Morgan City and Baton Rouge, La., for **Interstate Oil Pipeline Company.**

Engineers Limited Pipeline Company has started work on 86 miles of 34-inch loop line for **Pacific Gas and Electric Company.** The new line parallels the main line from Topock, Ariz., to Milpitas, Calif.

Louisiana-Mississippi Construction Company has contract for six miles of 10- and 12-inch transmission line near Burlington, N. C., for **Piedmont Gas Company.**

Rumsey Bros. Pipe Line Construction Company has started construction of 45 miles of 12-inch products line between Pasadena, Texas, and the Trinity River for **Sinclair Pipe Line Company.** This is part of Sinclair's new line from Houston to Port Arthur, Texas.

Southern California Gas Company is building 14 miles of 30-inch natural gas line between Indio and Willow Hole in Riverside County, California. Alex Robertson Construction Company, Paramount, Calif., is doing the work.

C. O. Holder Construction Company is completing 30 miles of four-inch crude line near Snyder, Texas, between the Fuller Ranch and The Texas Company Basin Station for **Texas-New Mexico Pipe Line Company.**

Houston Contracting Company has contract for construction of 34 miles of 6-inch butane line from Sour Lake to Port Arthur, Texas, for **The Texas Pipe Line Company.**

Buzzard's Bay Gas Company will begin work this spring on 28 miles of eight-inch gas line in the vicinity of Hyannis, Mass.

Iowa-Illinois Gas and Electric Company, Davenport, Iowa, has received FPC authority to build 22 miles of natural gas pipe line. The new line would connect with Natural Gas Pipe Line Company of America's system in Mahaska County, Iowa, and extend to a point in Ottumwa County.

Federal Power Commission has authorized **Kansas-Nebraska Natural Gas Company** to build a new ten-mile line off the Minden-Kearney, Neb., line.

Somerville Construction Company, Ada, Mich., has completed 14 miles of 24-inch natural gas line from Glenarm Station to Springfield, Ill., for **Panhandle Eastern Construction Co.**

Midwestern Constructors, Inc., Tulsa, has nearly completed work on two pump stations being built for **Sinclair Pipe Line Company,** at Quincy, and Pontiac, Ill.

Pipe is expected to be strung soon on **Texas Eastern Transmission Corporation's** line from Groveton to Waller, Texas. Anderson Bros. Corporation, Houston, is completing right of-way work on the 80-mile, 24-inch project.

Work on the **Lake Head Pipe Line Company** project from Ironwood to Cook, Mich., will start some time in May or June, probably. Anderson Bros. Corporation, Houston, is handling the 190 miles of 30-inch line involved.

Pipe laying will get underway soon on the 64 miles of 20-inch pipe line being laid by Associated Pipe Line Contractors, Inc., Houston, for **Cities Service Pipe Line Company.** The route stretches from Sour Lake, Tex., to Sulphur, La.

Williams Brothers Company, Tulsa, began laying pipe in January on the 75 miles of 24-inch line for the **Texas Eastern Transmission Corporation.** The line originates at Corrigan and moves to Center, Texas.

Trojan Construction Company, Inc., Oklahoma City, has completed right-of-way on the 80-mile **Texas Eastern Transmission Corporation** project which begins at Center, Texas, and travels to Castor, La. This is a 24-inch line.

Gulf Oil Corporation Starts Short Crude Line in Texas

The Pipe Line department of Gulf Oil Corporation has announced the company is building a 22-mile, eight-inch crude oil pipe line from the Portilla field, Nueces County, into Corpus Christi. The line will handle 10,000 to 12,000 barrels of oil per day and will terminate at the Pontiac Refinery. Some of the oil will be taken at the refinery and the rest shipped by barge or tanker. It is expected that the line will be completed April 1. Cost of construction will run in excess of $300,000.

UNIBOLT
X-BEANS

put needle valve selectivity in your positive choke...

74 sizes of X-Beans up to ½ inch

Because UNIBOLT X-Beans are drilled in increments of 5 per cent and 10 per cent of *well flow* rather than in increments of 1/64-inch in orifice size, the flow of fluid or gas from a well can now be *positively* controlled with a degree of accuracy never before attained. Say, for example, a well produces 100 bbls. through a 1/64-inch choke. To increase the choke to the next largest fractionally drilled size, 2/64-inch, would increase the production to approximately 400 bbls. On the other hand, a well that produces 100 bbls. through a size X-35 UNIBOLT X-Bean would produce only 105 bbls. through the next largest size X-Bean, X-35.5; 110 bbls. through an X-36, and so on. Here is positive protection against harmful over-producing a well in order to make its allowable, as is sometimes done through an adjustable choke.

UNIBOLT X-Beans are available in economical, renewable inserts in sizes up to X-40.5 (13/64-inch). Larger beans are standard full 6-inch length, drilled full length.

UNIBOLT Positive Choke Bodies and Cage Nipples accommodate either X-Beans or regular beans, and the Positive Choke Body may be easily converted to a Wing Valve or Adjustable Choke.

only UNIBOLT choke bodies and cage nipples accommodate X-BEANS

THORNHILL-CRAVER COMPANY

P. O. BOX 1184 — HOUSTON, TEXAS

W. C. Kinsolving

The Kingfish hopes to settle down someday . . . but now he's on the go from sun to sun.

W. C. (Bill) Kinsolving
'I talked the loudest . . .'

COLONEL William C. (Bill) Kinsolving hopes to build a house and settle down some day. He really hasn't had a chance, as he's been on the go since he joined Sun Oil Company in 1923 as a field electrician.

Bill was just out of Cornell University, with an electrical engineering degree in his pocket, when he went home to Texas and signed up with Sun. Today, at 51, he is president of Sun Pipe Line Company (Pennsylvania), board chairman of Mid-Valley Pipeline Company and a director of two other pipe lines, the Detroit Southern and the West Texas Gulf.

The Kingfish, as Bill is known to his fellow pipeliners, has grown up with the oil industry. "I got my first smell of oil when I was six months old," he remarks. That was on the day he had his first glimpse of an oil well. It was a mighty important well, too—the Lucas gusher at Spindletop.

William Carey Kinsolving was born March 17, 1901, at Corsicana, Texas, where oil was first discovered in the Lone Star State. His father and grandfather, both muleskinners, heard the news of the fabulous Spindletop producer which Captain Anthony Lucas had brought in on January 10. Mrs. Kinsolving and her son Bill, an only child, were packed into the family buggy, and they headed for Beaumont.

Booming, bustling Beaumont, where the population increased fourfold and where oil was selling for 3 cents a barrel and water for $6 a barrel, was a bedlam of activity. Bill Kinsolving's dad and granddad set up in business as teaming contractors, hauling heavy pipe and oil field equipment by mules and wagons to the well sites.

Bad luck hit the Kinsolvings, however, when Bill's mother came down with malaria in the damp climate of the new oil country. Selling out their business, the family moved to the drier area of Fort Worth. Bill attended public schools there, graduating from Fort Worth High School in 1917.

Across the Atlantic, a war was raging. Determined to do his part, Bill entered the U. S. Naval Academy in the summer of 1918. He spent two years at Annapolis, but events had changed his plans, and as Bill says, "the war was pulled out from under me and I didn't become a dashing naval officer."

He resigned from the Naval Academy and enrolled at Cornell in Ithaca, N. Y., as an electrical engineering student. While there he joined Chi Psi fraternity.

Back in Texas after graduation, he went to work for Sun, running power lines to leases, installing oil field motors and electrifying pumping oil wells.

His duties later gained him membership in that select and rugged clan who lay the pipe lines in the oil industry. But a young engineer, fresh out of college and full of new-fangled notions about graphs and hydraulics, could not expect ready acceptance by old-time pipeliners. The old rule of thumb methods were good enough for them.

Bill Kinsolving had to prove his worth. He did just that, in a day when pipe laying was done the hard way. Crews of about 250 men dug the ditches and put down the heavy pipe. Moving about the country and living in tents, they were a driving, brawling but intensely loyal lot.

"Kingfish," they called him. As Bill explains it, it was "because I talked the loudest and did the least work and thought up schemes."

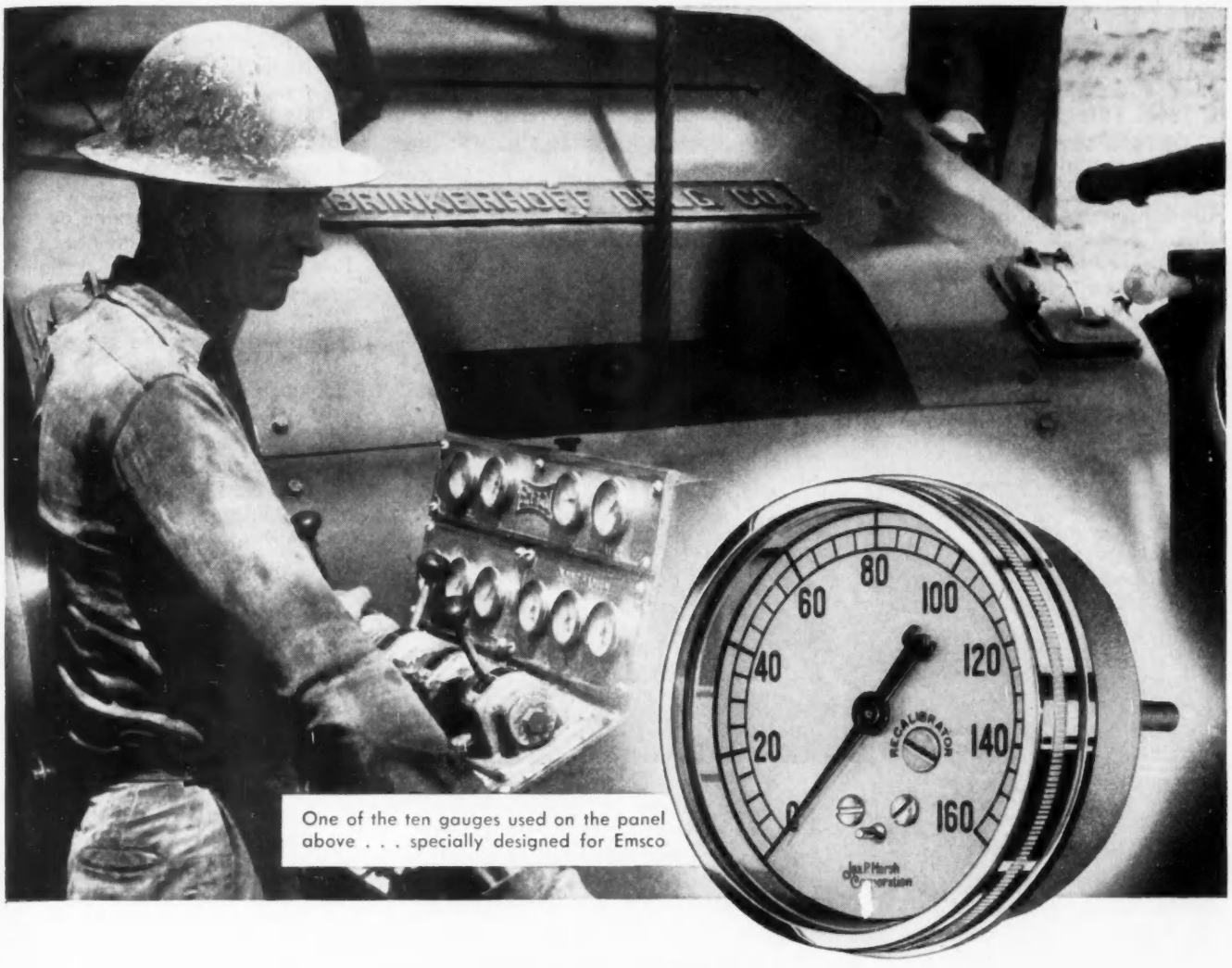
Despite the Colonel's assertion about "doing the least work," J. Edgar Pew, Sun's late vice president in charge of production, had other ideas.

A call from Pew took Bill to Philadelphia for what was to be a few weeks. Those weeks became years. He was only 28 when he was named chief engineer of Susquehanna Pipe Line, Sun's products line from Marcus Hook, Penn., to Cleveland. It was built in 1930-31 under Bill's direction. He did this job so well that he was asked to tackle another project, the East Texas to Beaumont line.

Bill was in Beaumont and had been with Sun about 15 years, when he asked Pew if it would be wise to build a house. "Sure, but I'd wait another five years to be safe," was the reply. He built the house but never managed to settle down, because in a year or so another call from Pew had him on the move again.

The mobility which Kinsolving acquired in his work for Sun served him in good stead when World War II erupted. To make certain American and Allied forces would have sufficient petroleum supplies, the government enlisted some of the best brains of the oil industry in the war effort. Bill was called to Washington in 1942 to serve as assistant director of transportation for the Petroleum Administration for War.

In this capacity, he figured prominently in the planning and construc-



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MARSH GAUGES

tion of the Big Inch and the Little Inch.

The Kingfish's stay in Washington was cut short by another call to duty in 1943. This time he found himself in Army uniform, with a colonel's commission, and aboard a plane bound for Calcutta. As a result of Allied promises of direct support to Chiang Kai-shek, made at the Cairo Conference, Colonel Kinsolving got the world's toughest pipe line assignment, the China-Burma-India line. It was to prove of vital importance in the war against Japan.

The Colonel was in charge of laying 1500 miles of line, stretching southwestward from Tinsukia to Calcutta, with a branch to the VLR (Very Long Range) airfields west of Calcutte. From these fields U. S. B-29's helped to carry the war to Japan.

The line crossed the Ganges, Brahmaputra and Hoogly rivers and pumped high octane gasoline over the "hump" to General Chennault's Flying Tigers and to the Chinese troops.

In contrast with peacetime supervisory duties which relate to the pipe line work only, Bill Kinsolving's India job involved all that plus complete responsibility for the health, welfare and morale of more than 1500 GIs under him. "It's made me some kind of expert on human relations, I suppose," he says.

Not only did they contend with such assorted perils as cobras, tigers, rogue elephants and jungle malaria, but also with the perplexing customs of Indian and Chinese coolies.

The Indian coolie uses a kadalie—a sort of short-handled, wide-bladed grubbing hoe—to dig ditches. His wife and kids carry the dirt on their heads in baskets. To speed things up, the Colonel supplied one of his native crews with wheelbarrows and long-handled shovels. It was no use—"they still dug with kadalies."

Looking back, the "Kingfish" says that "building that pipe line proves there isn't any place in the world where Americans can't string a line." In recognition of his service, he was awarded the Legion of Merit by the U. S. Army and the Order of Yun Hui by China.

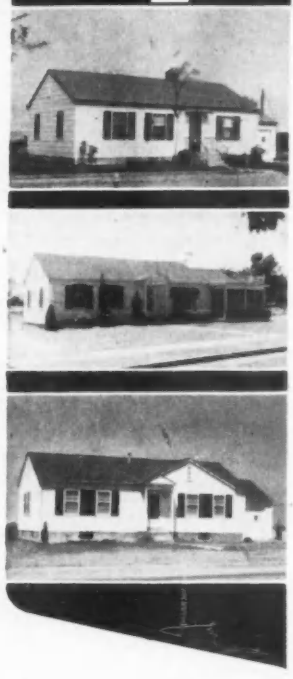
Bill returned to Sun's Philadelphia headquarters in 1946, as manager of all pipe line operations. In 1947, he was elected president of the Sun Pipe Line Company (Texas) and also of Susquehanna Pipe Line Company. When the two lines were consolidated in 1951, he became president of the new Sun Pipe Line Company (Pennsylvania).

His major postwar assignments included leading roles in planning the 1000-mile Mid-Valley Pipe Line, a 110-mile products pipe line in northern Ohio, a 125-mile products pipe line from the Toledo refinery to Sarnia, Ontario, and the 550-mile West Texas Gulf line now under construction.

In the Mid-Valley project, Bill and his associates performed a notable feat—the crossing of the Mississippi River. To keep the line in one place, it was necessary to give it "negative buoyancy." They pioneered the field by encasing the pipe in cement, thus spreading the weight evenly over the entire length. Older methods had merely clamped scrap iron along the line, but many lines broke at those points.

Kinsolving is a member of the American Petroleum Institute, Texas-Mid-Continent Oil and Gas Association, Pipe Liners Club of America, Philadelphia Country Club, Racquet Club and the Cornell Club of Philadelphia.

Some day he'd like to go back to Texas and do a little fishing—and build that house of his. But for the present he's too busy building pipe lines.



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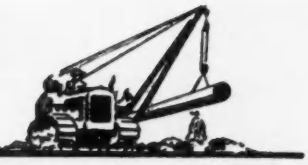


$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

Ramp Helps in Racking Pipe in Storage Yard

A ramp or skid can be a big help in racking pipe in a storage yard. A ramp made of a split section of pipe is smooth to minimize friction, and stiff to eliminate sagging and difficulty in rolling pipe up onto the rack.

To make the ramps, cut a 20-foot length of 8- or 10-inch pipe longitudinally in half. Narrow it about four feet from the lower end so it can be easily bent to proper contour. Also narrow the upper end, and make an overbend to run onto the pipe rack.

To use them, lay pipe runners toward the rack, and fit the lower end of the skids or ramps over the runners, with the upper end on the pipe which has been racked, as shown.

Chute Speeds Grading of Pipe

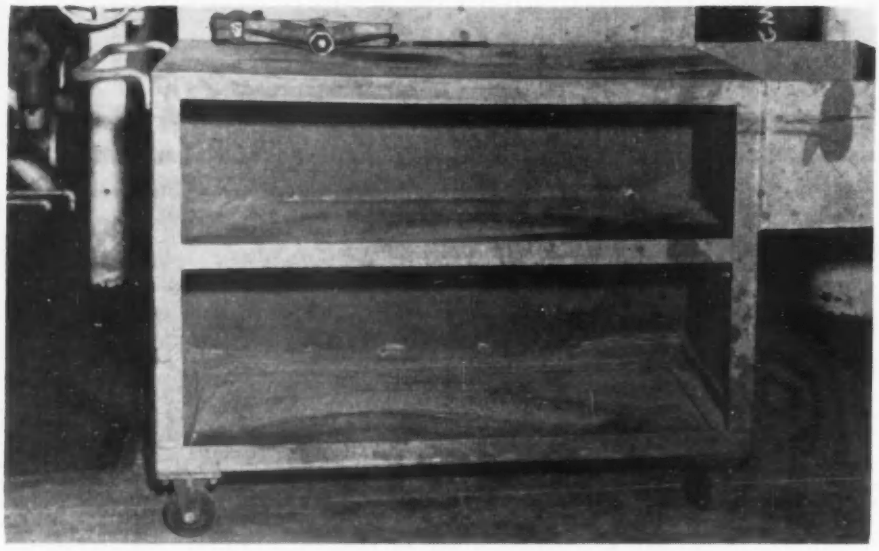
Pipe grading and racking in reclaiming yards can be speeded up by an "assembly-line" conveyor or chute made of rejected line pipe and pipe dollies.

In reclaiming yards one of the difficult problems is to grade each joint of pipe and then rack it according to its grade. In most cases the pipe is classed as "A," "B," "C" and "D." "A" indicates top grade pipe, almost like new, with little or no corrosion in evidence. "D" usually indicates reject pipe which should be sold for scrap. "B" and "C" usually designate pipe which needs straightening, patching, etc.

Where a reclaiming yard must handle as much as 30,000 feet of used pipe per day, the methods used in grading and racking become highly important.

Here's the way this particular reclaiming chute works. The pipe is rolled up onto the dollies which are suspended between the longitudinal pipe sections. It is checked for straightness, pitting and other defects, and the inspector grades it and writes the classification on the pipe. Then the pipe is shoved down the long line of dollies which run alongside all pipe racks. When the pipe comes opposite its designated rack, workmen roll it out of the chute and onto the rack.

To make the pipe chutes, space 30- or 40-foot lengths of 8- or 10-inch pipe on skids cut from scrap pipe. Space them far enough apart to permit the dollies to fit between them. Then attach the pipe to the skids with steel scrap. Next, cut holes in the side of the pipe and drop the rollers into place. Tack weld them when they are centered between the two runners. These rollers should be spaced about ten feet apart.

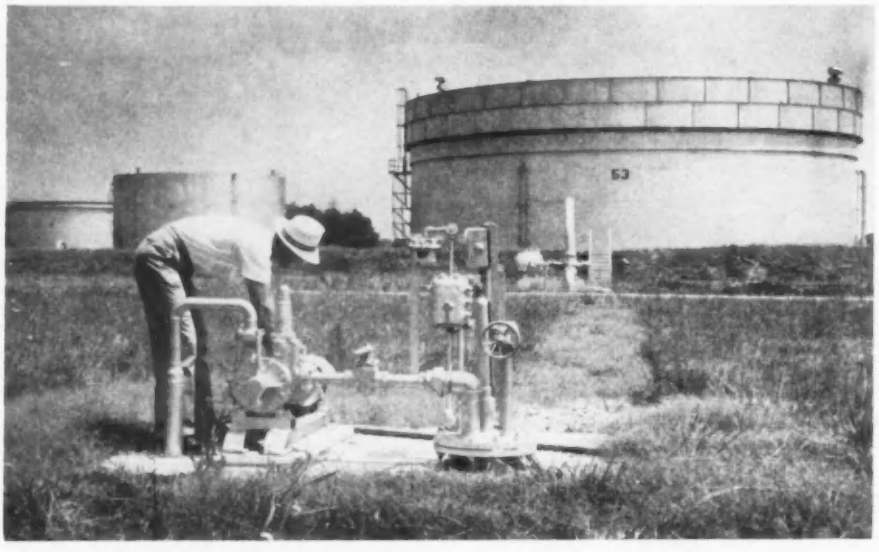


Casters Provide Portable Bench

A work bench made of steel plate can be mounted on casters to make compressor building maintenance easier. When repairs are to be made, the bench with its two shelves can be loaded with spare parts and tools, and wheeled right up to the engine to be repaired. As work proceeds, tools and the parts removed from the engine can be stored in the mobile workshop table.

To make the table, first build a framework of light angle iron. Cover this frame with light gauge steel plate. On the bottom, mount four casters—two of them need not steer. At one end of the bench weld a handle made of bar steel. At the other end, weld a metal box for storing wiping rags, etc.

This table imparts a business-like organization to a repair job. No longer are tools and parts scattered about the floor and on the engines.



How to Reduce Products Loss

A vapor recovery system is saving thousands of dollars worth of products formerly lost to the atmosphere, the number one thief that plagues products storage tankage.

Ordinarily, when tanks are emptied, fresh air enters the tanks to replace the outgoing product. This air saturates itself with vapors at the expense of the contents of the tanks. Then when the tank is refilled, the vapor-laden air is pushed out into the open, carrying with it never-to-be-reclaimed gasoline, kerosine and fuels.

By hooking four cone roof tanks together with a common header and then attaching this header to a floating roof tank, one company diminished the losses. The "put" and the "take" more or less compensated for one another, and the gain or loss was stored in the floating roof tank. Losses were cut still further, by running the common header into a sump. This sump was cool enough to condense many of the hydrocarbons, which, as they were collected, were analyzed and pumped into suitable tankage. Thus the air leaving the tank system was further relieved of its valuable burden.

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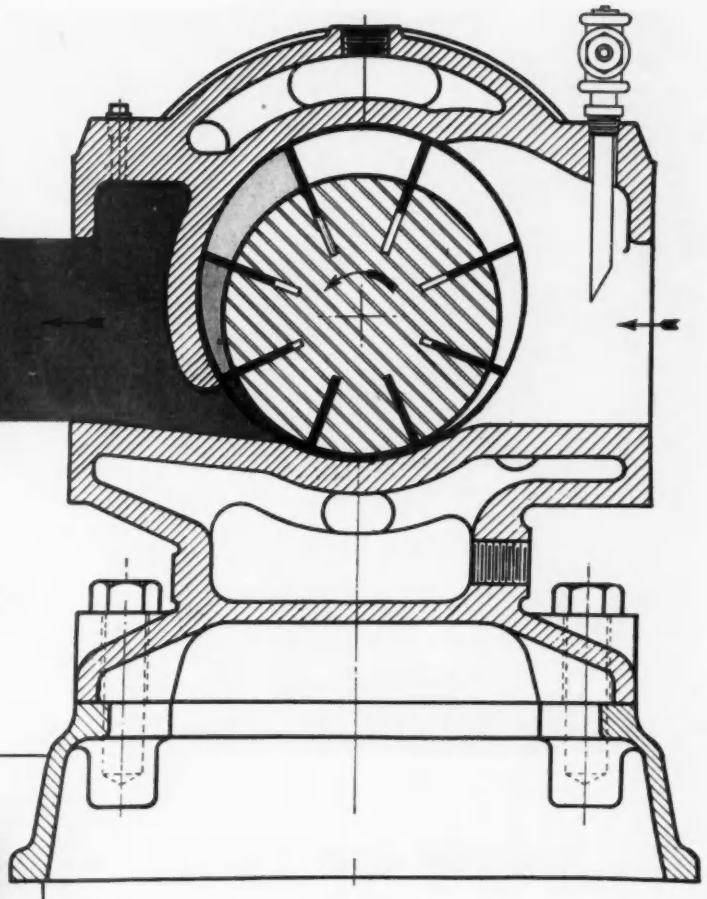

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Seal Protects Field Joints

Insulated field joints can be permanently protected from corrosion by following a few simple steps.

The method consists primarily of acquiring a complete seal-off from outside corrosive agents by use of a hot application of some type of commercial coal tar enamel over the complete insulated joint.

To assure a permanent seal, use this procedure:

1. Brush the insulated joint with a stiff wire brush;

2. Dust and clean the joint free of any loose or foreign material;

3. Apply a base of coal tar enamel primer over the entire flanged joint and allow to dry for approximately 15 minutes;

4. Using asphalt saturated pipe line felt, construct a cone or band, whichever the case may require, around the joint. This insures against voids in the enamel by temporarily holding the enamel around the joint and allowing it to flow freely into the flanges;

5. Slowly pour the enamel into the opening in the felt and allow to cool;

6. Inspect the coated joint closely to make sure the seal is complete.

If it should later be necessary to remove the insulation, heat the enamel and it will melt away from the joint.

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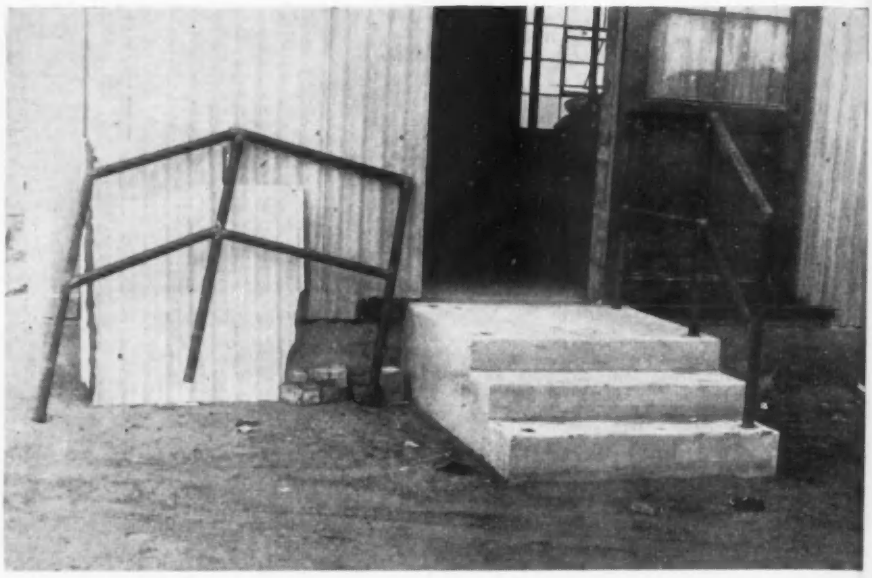


Rails Mounted in Pipe Sleeves

An efficient way to mount hand rails on concrete steps and stoop is to pour pipe sleeves in the concrete and later made the hand rails to fit inside these sleeves. This simplifies one of the small end-of-construction jobs that can add a great deal to the overall cost of the station.

The pipe sleeves are made of pipe one size larger than the hand rails. For example if the hand rails are to be 1½-inch pipe, the sheaths should be 2⅜-inch. They should be blinded off and inserted in the concrete just before it starts to set up. Or they can be held in place with templates attached to the concrete forms.

After the concrete has set up, measure the exact distances between the sleeves and also the depth of each one. Then make the legs of the hand rail assembly fit the holes.

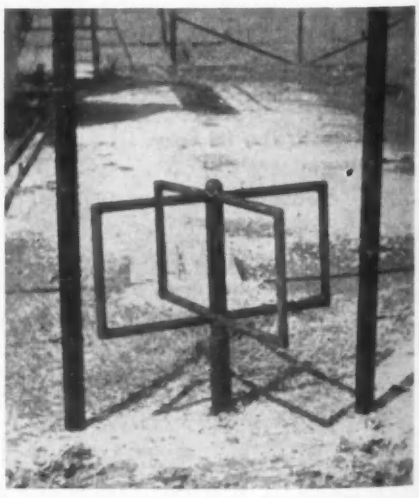
The same technique can be applied to the elevated walkways, etc., often around stations. However, instead of pouring individual piers, money can be saved by pouring a trench of concrete neat, with the sleeves spaced to fit the walkways which will be added later.

Revolving Gate Made of Scrap

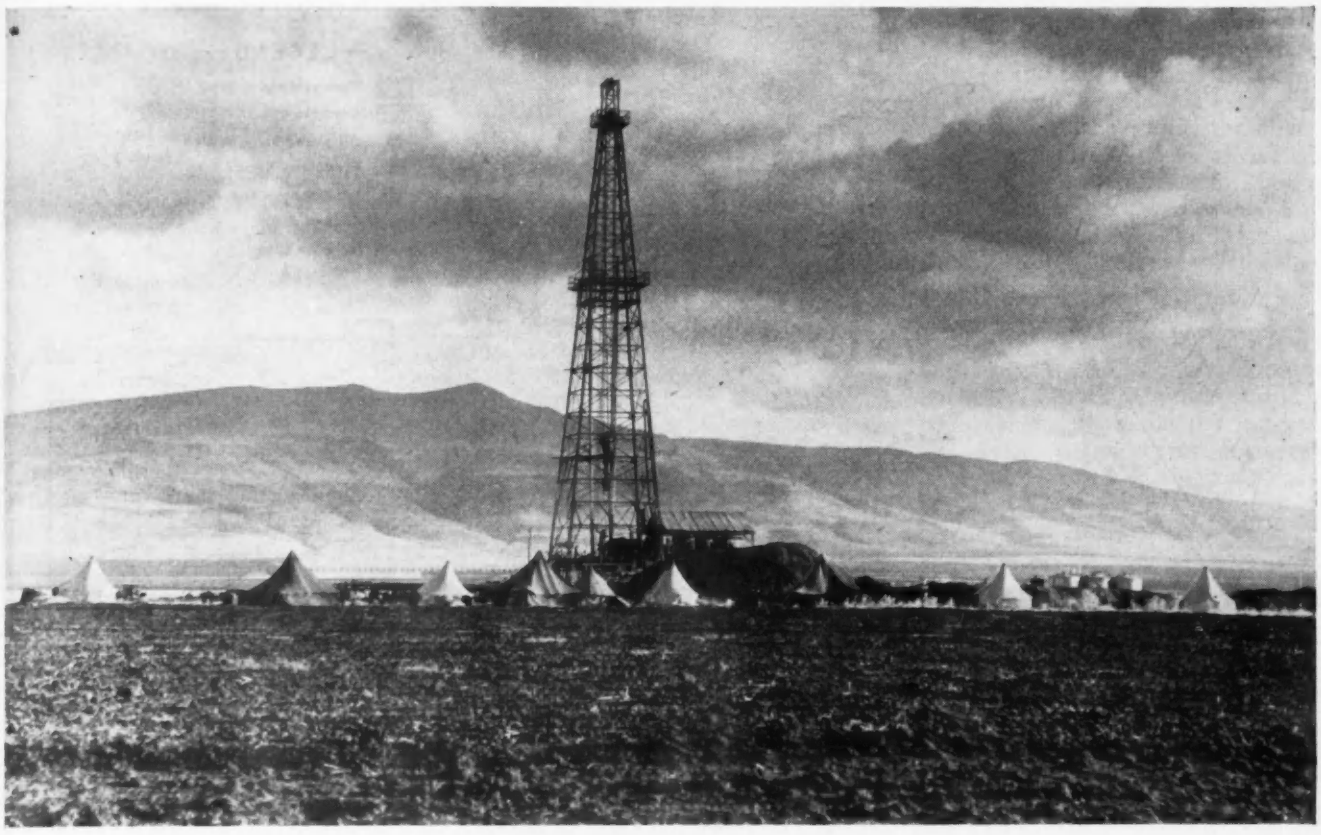
A turnstile that can be used conveniently at many tank battery and station locations is made of scrap material.

Short pieces of 1-, 2- and 2½-inch scrap line pipe are used for the revolving gate. The base or foundation is a piece of 2½-inch pipe driven three feet into the ground midway between the two fence posts. A small amount of concrete may be poured around the base for insurance, but in many cases is unnecessary.

The short pieces of one-inch pipe are welded at 90-degree angles to the two-inch pipe as shown. The two-inch section used as the main support for the gate is three feet long, and slides inside the foundation pipe. A heavy bead welded around the circumference of the two-inch pipe about two inches below the horizontal bars enables the gate to revolve on the base.



This type of gate will never be left open, ajar, or require unlatching before entering. There is no problem of hinge repairs.



—Photo by J. Belin

Wildcat OR2, three miles from Petitjean, Morocco, with ridges in background, cultivated plains in foreground. Moroccan workers live in tents.

Morocco—A Country on the Threshold of Greater Wealth

Strategic position, ore deposits and growing crude production point to the Sultan's country as the one to watch.

By DR. J. BRIAN EBY
Special WORLD OIL Representative

With a 1952 oil production of about 750,000 barrels and a promise of more than a million barrels in 1953, Morocco is about to become a major oil-producing country. Local production already is filling about 15 percent of the country's petroleum needs.

Societe Cherifienne des Petroles, commonly called SCP, is the only oil exploration company in Morocco. It is owned 40 percent by the French government, 40 percent by the Sultan of Morocco, 11 percent by the Compagnie Francaise des Petroles, and nine percent by private interests. Pierre Taranger is general manager with offices in Rabat, the national capital. Andre Berquint, manager, and Raymond G. Levy, chief geologist, direct field operations from the inland city of Petitjean, 80 miles due east of Rabat. They are assisted by C. Reure, drilling superintendent, and J. C. Schoeffler, geologist and geophysicist.

Geographically, French Morocco is bounded west by the Atlantic Ocean, north by the Rif Mountains, east by Algeria and south by the Sahara Desert. Three mountain chains cross the country in a northeast-southwesterly direction: the Moyen (Middle) Atlas on the northwest, the Grand (High) Atlas in the center, and the Anti Atlas on the southeast. The Oued (river) Sebou drains the large flat area of northwest Morocco known as the Rharb basin or plain and reaches into the Atlas ranges as far east as the ancient Arab and Berber capitals of Meknes and Fes.

Before the arrival of the French in 1907, the Rharb basin was a vast malarial swampland. Starting with the general pacification of the country in 1912, the French with tremendous effort drained hundreds of square miles of the Rharb plain, turning it into excellent farmland. Great forests of cork oak have been planted and large areas of grapes, cereals and olives are now being cultivated on this former marshland.

The importance of the minerals of Morocco is highlighted by the strategic location of the country. It is a natural gateway from the Americas to Asia and from Europe to Africa. Its entire history has been one of turbulence and both national and in-

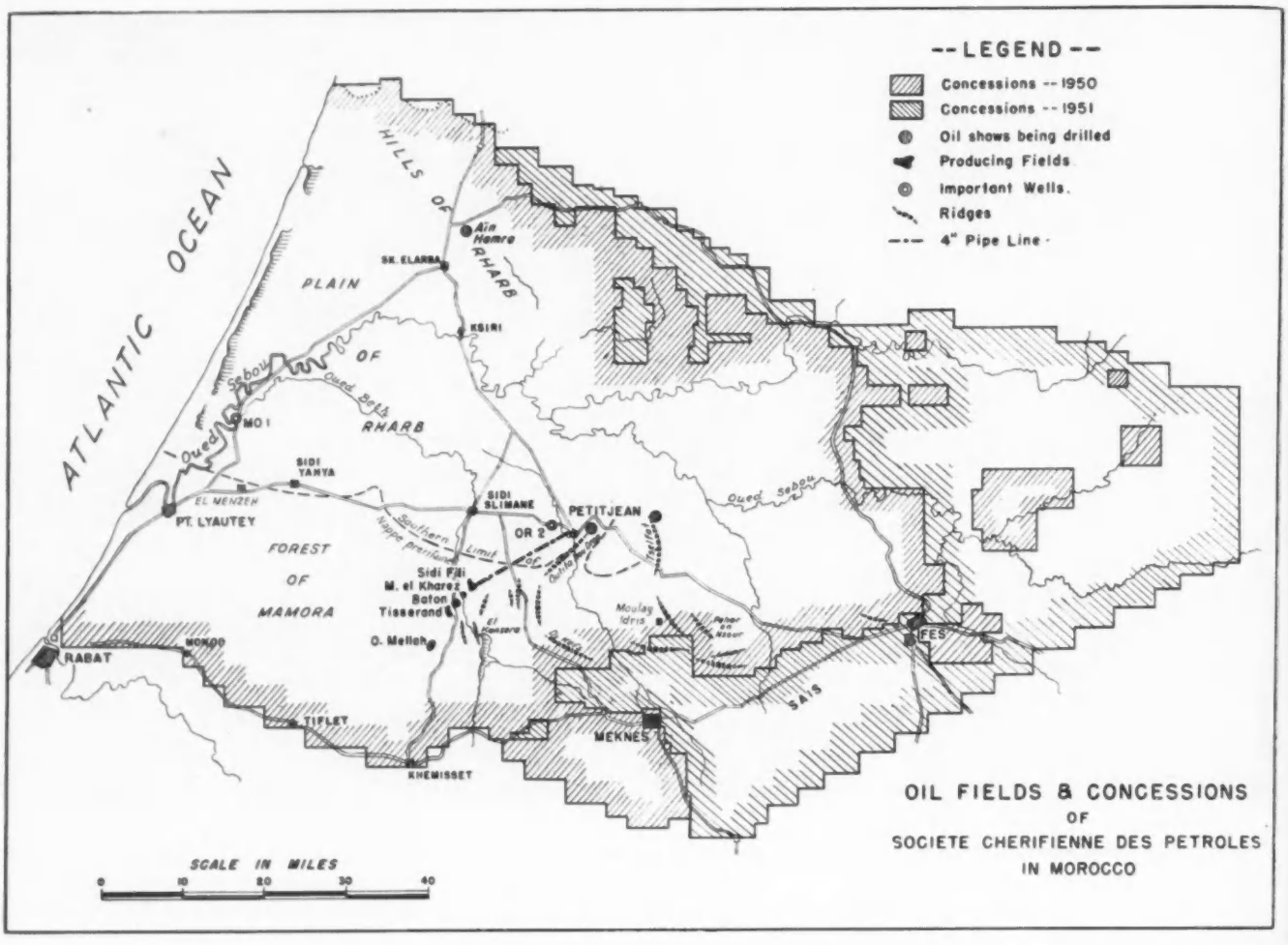


FIGURE 1.

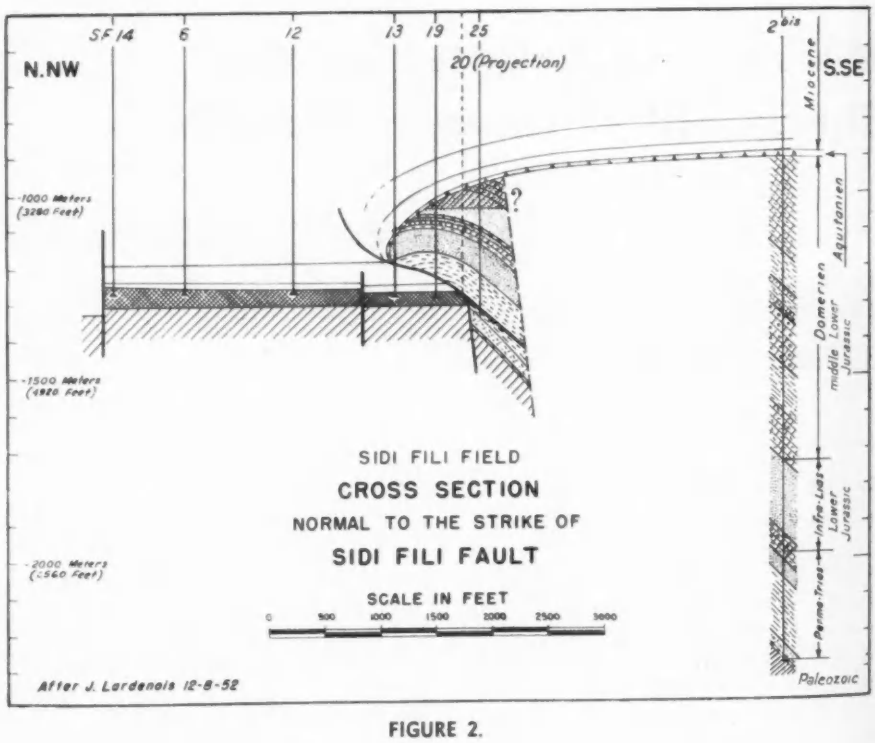


FIGURE 2.

ternational crises. This could only happen to a country rich in phosphates, manganese, lead, coal and now oil, and vitally located in the stream of international lanes of transportation from the ships of the Phoenicians, 800 B.C., to the airlines of today.

The present government of Morocco, the French Protectorate, is headed by the Sultan, H. M. Mohammed ben Youssef, who is advised by a French Resident General, at this time General Augustin Guillaume. The Sultan and the Resident General make every effort to meet the native on an equal footing with the French colonizers. At every level of administration there are French and native Moroccan "opposites", each one to carry out the orders that affect his respective peoples.

The French are protecting, as far as possible, the religion, customs, and culture of the Moors. From Sultan to tribal chiefs, on every level, the French have advisors whose duties are to approve the legality of native decisions and often protect the natives from dangers the natives themselves would not recognize. The French are trying to keep the native on the land—and agricultural schools, training in irrigation practices and cooperative plantation growing of olives and in farm and livestock products have been most successful. Native workers, from roustabouts to micropaleontologists, are now being used in the oil fields.

Societe Cherifienne is now develop-

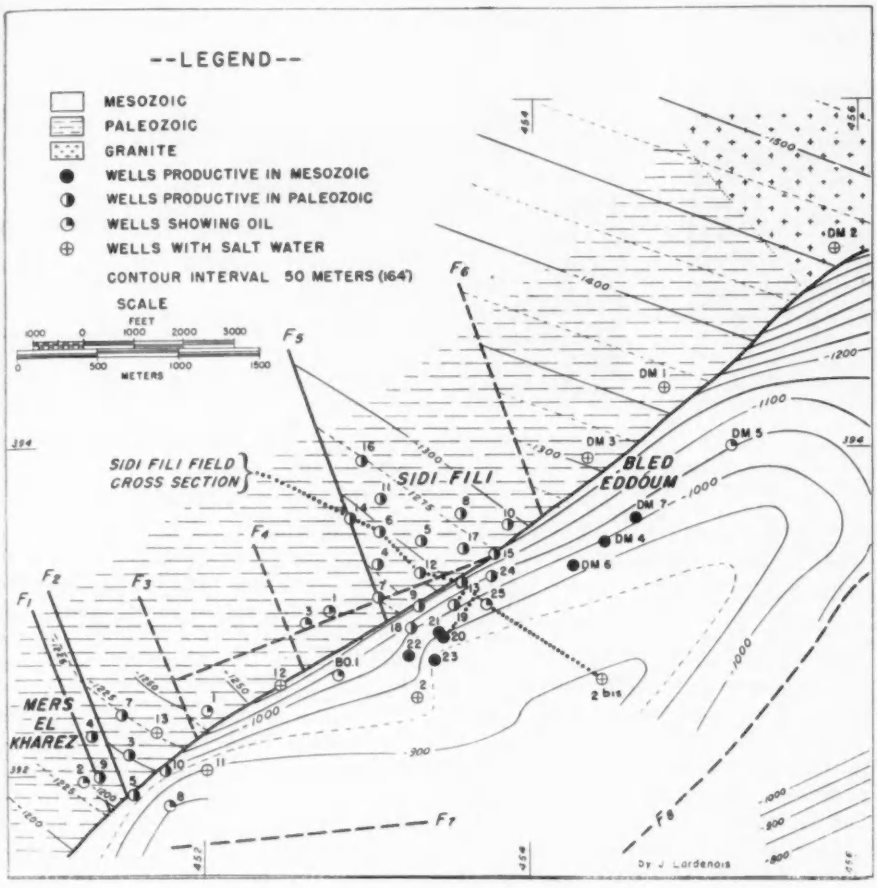


FIGURE 3.

ing five oil fields and operating a half million-barrel annual capacity topping plant at Petitjean. It holds 1934 mining permits or concessions (see Figure 1) totaling 7850 square miles. The total holding by law of any one company is 25,000 hectares, or a little over 9800 square miles. The right to apply for concessions is not restricted to French or Moroccan citizens.

The five producing fields of Morocco extend along a northeast-southwest trend about 70 miles east of Rabat and a little to the southwest of the railway town of Petitjean. Three of the fields—Oued Mellah, Tisserand and Baton — lie along the Oued Beth river and are

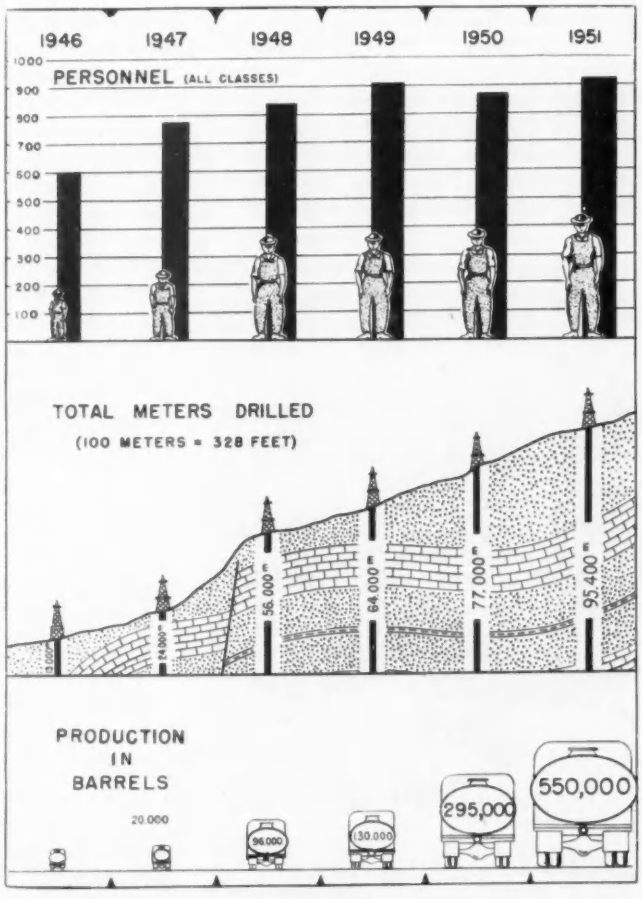


FIGURE 4.

usually grouped as the Oued Beth district. The other two fields are Mers el Kharez and Sidi Fili-Bled Eddoum.

Three small fields, Tsclfat, Ain-Hamra and Bou Draa, the first of which was discovered by oil seepages in 1919, are now exhausted. The company plans secondary recovery methods on Tselfat field. The locations of these fields and the producing fields and one small gas field, El Menzeh, are shown in Figure 1.

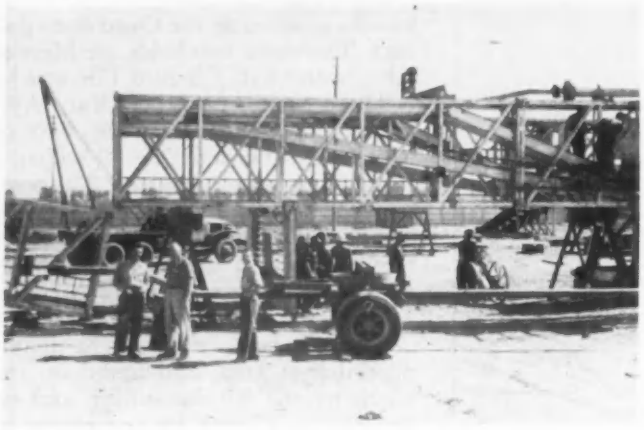
The oil fields occur in a major depositional area, dominated on the north by the Rif Mountains and on the east and south by the ranges of the Atlas. Between the features a major sedimentary basin exists known as the Rharb, the low plain of the Sebou River. This basin is estimated to contain a thickness of 8000 feet of Miocene beds alone.

Along the south front of the Rif Mountains, called the Rif Zone, is an area of uptilted beds of Jurassic and Cretaceous age known as the Prerifaine Zone. These rocks are largely limestones, marls and calcareous beds. During deposition in the Tertiary basin to the south great masses of the Prerif rocks were pushed or slipped into the Miocene Sea, resulting in a broad area of Tertiary rocks interbedded by Mesozoic rocks. This area of intrusion is called by the French geologists the "Nappe prerifaine," and the "front of the Nappe" extends from Port Lyautey on the Atlantic Coast due eastwardly to Petitjean (see Figure 1). At this point, the Nappe meets a series of northeasterly-southwesterly hills called the "Ridges of the Prerifaine" composed of Jurassic and occasionally Triassic beds. Cretaceous and Tertiary beds are also involved in the uplift of the "Ridges."

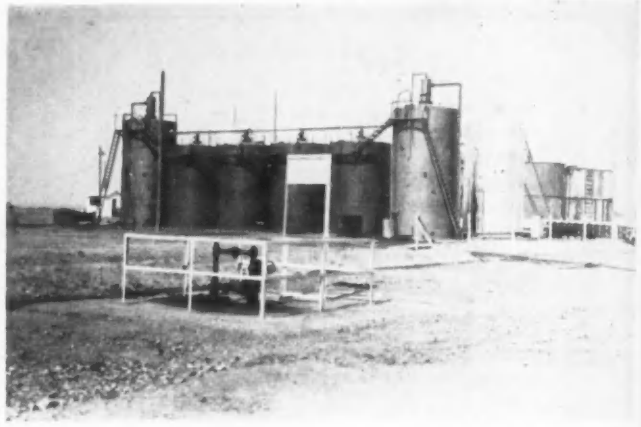
The present producing fields lie just west of the "Ridges" and south of the edge of the "Nappe" (see Figure 1). The small methane gas area just north of El Menzeh, near Port Lyautey, is a Miocene sand. No oil has been found here, but hopes are high for future exploration.

All oil in the Rharb basin comes from rocks of either Jurassic or Paleozoic age in the extreme eastern edge of the basin. Levy believes the oil to have migrated from the basin into the older rocks as the Paleozoic beds are for the most part schists that are impregnated only locally and only in favorable structural situations. The fields are all controlled by fault patterns, usually small horsts of uplifted segments.

Oil from the Jurassic rocks is 39.5 gravity and the oil from the lower Paleozoic schists ranges from 25 to



SCP derrick being unloaded near Petitjean.



Well 4, Sidi Fili field. Tank battery in background. This was discovery well for entire district.

36 gravity. As pointed out by E. J. Brill at The Hague 1951 Petroleum Congress, these reservoirs are not unlike the "basement complex" fields of California, especially the Edison field of Kern County.

The irregularity of these Mesozoic intrusions into younger beds and the later cover of flat-lying sands and shales make the interpretation of the geology most difficult. The geophysicist is taxed to unravel the truth from his data and much must depend a great deal on the drill and subsurface investigations. It is one of the most intricate patterns of geologic structure and has a high value of wildcat hazard. The cross-section of the Sidi Fili field and fault (see Figure 2) shows both the stratigraphy and general structure, not only of the Sidi Fili field but in general the other four fields as well.

The Baton field was discovered October, 1947, with well OB7, making 2100 barrels per day on initial test. The oil comes from a slate or schist, 3000-foot depth just below the Miocene cover. The estimated reserve of this field is from three to four million barrels.

Sidi Fili was discovered in May, 1950, and currently is the best field. There are two producing horizons, one at 3850 feet and one at 4600 feet, and both horizons give up 39 gravity oil under casing pressures from 1500 to 2100 psi.

With discovery of these two fields, a four-inch pipe line was laid to the Petitjean topping plant 16 miles to the northeast. The Petitjean topping plant has a capacity of 2500 barrels daily and produces four products, gasoline 13 percent, kerosene 10 percent, gas-oil for Diesel fuel 35 percent, and fuel oil of low viscosity 42 percent. The gasoline is low in octane count and must be mixed with imported gasoline. The fuel oil is sold to Socony-Vacuum Oil Company, Inc., and taken to France for further refining.

With the present rate of production, the Petitjean topping plant is able to supply 70,000 barrels of gasoline each year to the some 80,000 motor cars and trucks operated in French Morocco and whose consumption is over 2 million barrels a year. On the other hand, it is hard for the SCP to find a commercial outlet for its heavy fuel oil production of more than 300,000 barrels a year. To cope with this situation, a Thermofor-type catalytic cracking unit has been ordered to convert some of the heavy fuels into lighter products.

The importance of the search for oil in Morocco may further be seen in the intensive wildcat campaign now being waged. SCP is operating two reflection seismograph crews, equipped with American instruments and shot-hole drilling rigs. The crews are French. Gravity, magnetic and geological surveys are carried out in detail. With the SCP being organized in 1946, wildcat drilling went from 64,900 feet in 1947 to 220,900 in 1951, and a still larger record is expected for 1952.

—Photo by J. Belin

This discovery well of Baton field, Oued Beth district, Morocco, produced approximately 120 barrels per day with 450 psi.

In spite of this progress in exploration and drilling, SCP was still in the red financially by the end of 1951, having earned only 92 percent of expenses that year. In 1950, however, the earnings were only 30 percent of expenses. The year of 1952 should show a profitable earning by the company.

SCP is using Moroccan help wherever possible, and local personnel and labor works 48 hours a week. With Friday the Mohammedan religious holiday, Sunday is largely a work day for local labor.

The main highways in Morocco are macadam and the railroad from Oran to Casablanca is in excellent shape. The line is electrified from Fes to Casablanca, a distance of more than 200 miles. The cities of Rabat, the capital, and Casablanca, the metropolis, are modern and active centers of industry and commerce.

The establishment of U. S. air bases in Morocco will unquestionably give a lift to the economy of the country and focus attention on the strategic importance of the area. The largest of these bases is Sidi Slimane, only a few miles west of Petitjean. The construction of several large dams, one on the headwaters of the Oued Beth, insure water power, and irrigation for large areas. More are planned. Like the oil business in Morocco, the total economy of the country is on the rise and opportunity is there.

ACKNOWLEDGMENT

Grateful acknowledgment is given to Societe Cherifienne des Petroles for its full cooperation. Special thanks are due Raymond Levy, chief geologist, who made many office facilities available and arranged for the author's visit to the oil fields. J. Schoeffler, geologist and geophysicist, was an excellent guide on the oil field tour.

Global Oil and Trouble Grow Together

An uncooperative government and an uninformed public plague the industry today.

By DR. CORNELIUS ZONDAG

Editor's Note: This is the second of two articles describing the trials and tribulations of international oil in a changing world—and what can be done to overcome them.

IF THE GOVERNMENT really wants more oil in strategic places, it should stop letting the industry down as it has done in the last decades. The recently-published report of the President's Materials Policy Commission points out that fear of expropriation and of discriminatory taxation is today foremost in the thinking of American companies operating abroad.

There is a definite task for the government here. While the time for gunboat action has long passed, there certainly is room today for a bit of diplomatic bargaining.

We talk a lot about Point 4, our new policy of "Show me how." Yet, a lot could be done in some countries by pointing out how things should not be done. Nationalization certainly has given no indication of being good for either the backward nations or the so-called "imperialist nations."

Let us look at a few examples.

- Under the incentive of adequate oil legislation, oil production in Mexico reached more than 500,000 barrels a day as early as 1921, a figure which dropped sharply after the expropriation in 1938. Today, Mexico produces only a little somewhat more than 200,000 barrels a day though it has excellent oil possibilities.

Contrast this with Venezuela, where production rose from about 4000 barrels a day in 1921 to more than 1.7 million barrels a day in 1951. An enlightened petroleum policy transformed Venezuela within 30 years from a semi-jungle into a fairly modern country with a national treasury income of $630 million, 26 times greater than in 1921, and no foreign debt. Today, agriculture, rural electrification, new industries and intensive roadbuilding are booming under the impact of an ever-growing oil industry.

- In 1918 Russia nationalized its oil. It has been plagued by shortages ever since.

- In the late 1930's Bolivia expropriated foreign companies with disastrous results.

- In 1938 Brazil set up a National Petroleum Council to develop the oil industry in all its aspects. It now produces a little more than 1800 barrels a day, or 1 per cent of the national consumption. The expense has been considerable.

- The 1951 story of Iran lies fresh in our memory.

Today Venezuela is the best example that the slogan "The petroleum is ours" may sound pleasing to the nationalistic ear, but is certainly less pleasing to the national pocketbook.

While the United States government professes to be quite anxious for more American investments abroad, it has done very little in recent years to support the petroleum industry, the nation's largest private investor abroad. The anti-trust proceedings started some time ago by the U. S. Department of Justice against five American and two foreign oil companies are a good illustration of the government's dualistic attitude.

The State Department has practically been a party to everything the oil companies have been doing in the Middle East in the past two years. Yet at the same time another department of the government virtually calls the oil industry part of a world-wide cartel and thus subject to prosecution.

Granted that anti-trust action may be a nice horse to ride in an election year—since the public is unaware of the real facts—it is most unfortunate that the government chose this particular time to start another legal action against companies which have committed no other crime than to provide the Middle East with its greatest wealth and the Western World with vital products.

After World War I, when there was another big scare about the future of our petroleum resources, the industry proved in no time what it could do with adequate backing. As a matter of fact, the strong diplomatic support of the '20's gave it the foothold in many foreign lands from which present operations have grown. This is in sharp contrast with the policy of later years, when American diplomacy took the form of post facto justification of nationalization tactics rather than taking steps to prevent it.

A more dynamic information policy should play a bigger role in industry thinking if the industry wants to put up a successful fight against government control. It should see to it that the public knows more about the oil which it uses in such quantities. As things stand now, the American public is showing an incredible indifference to the ultimate fate of an industry which affects the daily life of everybody.

This lack of public information is all the more regrettable as the petroleum industry has such fascinating aspects which appeal to the public imagination. While the average motorist knows more or less where his gas and oil comes from, he hardly ever suspects that petroleum involves the roof over his head, his wife's dishwashing, her makeup, the radio cabinet, the daily paper, dinner with candlelight and many other things. And this is only the beginning. Petroleum chemistry is expanding every day.

Hardly ever is the American motorist aware of the extreme competition in modern oil refining and marketing in America. To quote Max Ball, Washington oil consultant: "If all

business operated on the same scale as the American gas station, the butcher would bathe your dog whenever you buy a pound of scraps."

Perhaps we have become too much used to this service. It is part of our life. Not so long ago an American tourist in France asked the gas station attendant to wipe his windshield. Furiously, the attendant threw the rag in his face and told him to do it himself or go back to America. Selling oil in France must definitely be easier.

Unfortunately, it is only when things go wrong that John Doe starts to notice the industry. Some people have even gone so far as to call the public's indifference the biggest compliment to the industry. While in some countries the public constantly gripes about oil shortages, the American motorist hardly noticed the overnight loss of 700,000 barrels a day from Iran. Making up this loss was virtually a "man bites dog" story. Yet the public hardly realizes it.

It is not enough to quote statistics such as that since 1940 world production of crude has jumped from less than 6 million barrels a day to the present 12 million barrels a day, or to tell the public that there are more than 35,000 oil companies in the United States. Let us explain more clearly how the industry operates so that people will be better equipped to think for themselves if and when new charges are made against it.

As uninformed on oil as the American public is, it knows far more about the industry than the foreign man in the street who is frequently plainly hostile instead of just indifferent. To deal with this situation calls for a much more subtle approach.

The petroleum industry should make it clear what it is contributing to the countries in question beyond such obvious things as schools, employment and sanitation. People abroad should be made much more aware of the fact that oil development is essentially a partnership betwen the government and the operator. Although they may disagree sometimes in detail, both the government and the operator are interested in finding oil at the lowest cost.

Finding oil abroad takes a long time and a lot of money. It is a big company field only. Experience has shown that even the smaller companies cannot do it successfully. The recent experience in Western Canada provides an excellent example of the risks involved in petroleum production. During a ten-year period ending in 1946 more than $50 million was spent in Western Canada on oil and gas exploration.

In terms of production, the results were so mediocre that in 1946 came the first sign of a showdown in exploration. Imperial Oil Ltd., alone had invested $23 million in exploration during a period of 20 years before it brought in its Leduc 1 well early in 1947 which reversed the trend. Immediately after the discovery, Imperial launched a $50 million development program followed by the further immense investments with which we are now familiar.

All too often people look only at the success story and forget that many investments end in a total loss. Costly operations in Cuba in the early '20's are clear examples of investments that were completely lost. Large sums were spent in Central America without any return. Many a government would have gone bankrupt if it had had to take the risk some companies took.

It is obvious that because of these risks the operator needs adequate protection in order to know where he stands when oil is found. In taking the geological risk, the operator is taking on a big gamble. Yet, it is sad to say that today the political risk is often much greater than the geological risk.

Fortunately for the industry, basic principles of petroleum production and refining are fairly simple. Anybody can see that in levying ever-increasing taxes, the oil of a particular country may price itself out of world markets with the most disastrous results for the local economy.

There was a time when a glance at the royalty rates was often sufficient to determine whether or not the operator could still make a profit abroad. Unfortunately, this is no longer true. Restrictions on ownership, remittance of profits, forced investments, special foreign exchange rates, sale of the oil to the government at fixed, low prices, government control of exports, changing depletion rates and prohibitive drilling obligations, government interference in purely technical matters, dangerous reversion clauses—these are only a few of the factors an operator has to consider before risking his money.

In dealing with the growing ambition of nations to have their own national petroleum industry, the industry should show the foreign public much more clearly how the type of product and the interdependence of petroleum producing and consuming countries made the industry essentially an international industry. Only by operating on a highly-integrated world-wide scale has the industry been able to offer the best deal to the consumer. By its very nature state enterprise could never do this. There is no intricate scheme behind the industry's pattern. It is just a logical, historical development.

It is incredible that apparently well informed people occasionally advocate the nationalization of the U. S. petroleum industry while everybody who takes the time to read a concession contract to the end knows that such an act instantly would kill all our concessions abroad and, consequently, all foreign production, of which we say we need more.

These facts are not so difficult to understand that the industry could not capitalize on them. Almost anybody knows what competition means. Almost anybody can understand that it would be folly to put up a large modern refinery without adequate access to transportation. Almost anybody can understand that a large refinery can operate more efficiently than many small ones. Yet, the industry is constantly faced with demands which result more from political expediency than business efficiency.

The average person would not like to build a factory if he had to turn it over to the government within a few years; yet the industry often has to sign a reversion clause, turning over its refineries to the foreign government after a fixed period of years.

Finally, the industry should show a just pride in its labor relations which speak for themselves. The record refutes the many loose charges made against it, for the petroleum industry has been outstandingly progressive.

We live in a time of rapid social changes all over the world. The more the average person knows about the industry, the better off it will be, as full knowledge can only result in a decrease of some of the preposterous statements often made by irresponsible people.

Along with the job of educating the public, it is necessary to better inform company personnel on all levels so as to make them more active supporters of their industry. The industry's public relations program is doing all it can but it can never be expected to do all the work. The average oil man is often too much on the defensive when asked about his industry, even if he knows the answer. This attitude, which may be a leftover from the early days when being in the lime-

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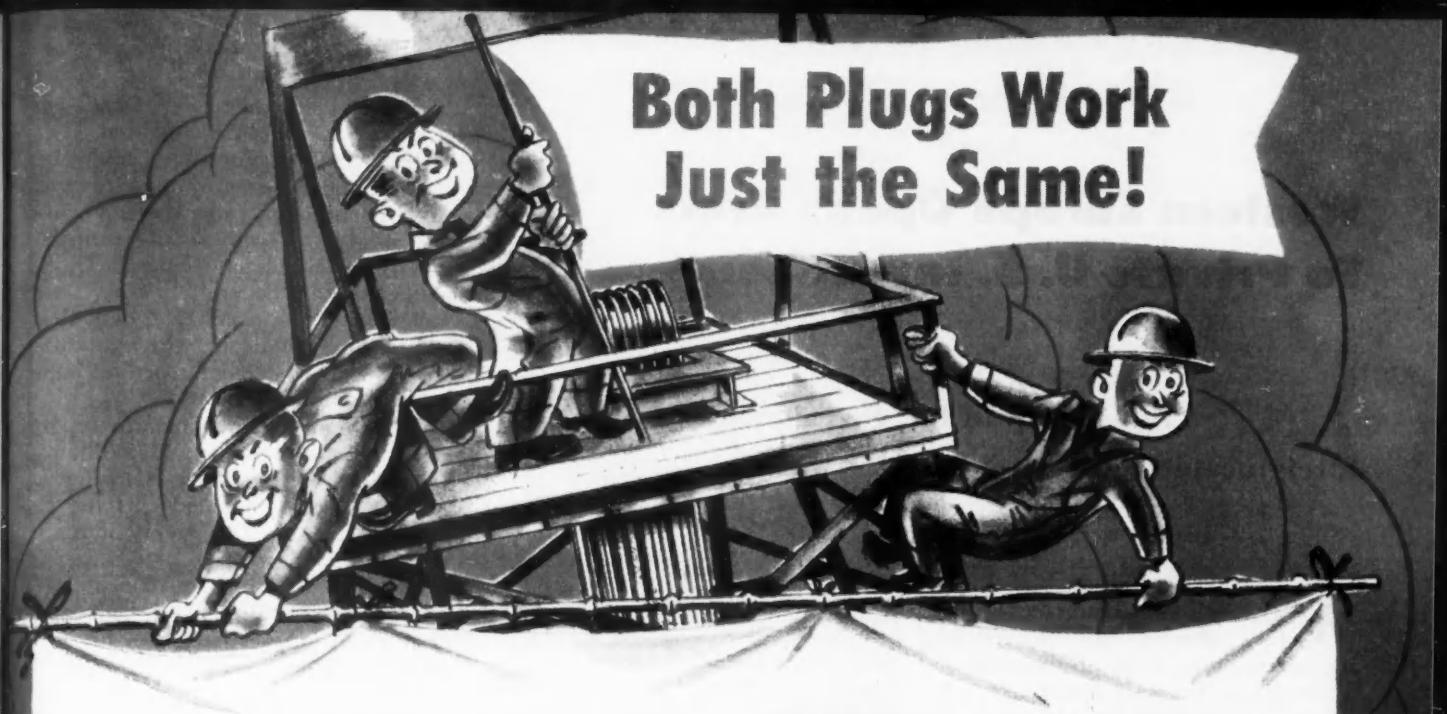
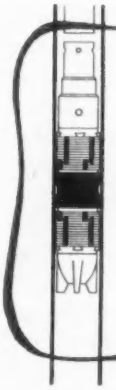


1 When the setting action is started, the packing element is first to contact the casing.

2 At almost the same moment, the upper slips begin to grip the casing, halting any upward movement.



3 Then the lower slips take hold, stopping any downward movement. The entire action is timed to permit full expansion of the packing element.

RESULT:
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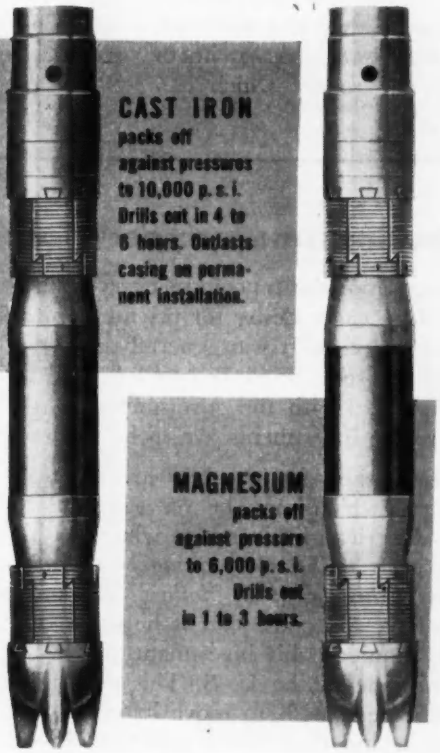

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Western Europe Opens Arms To Private U. S. Investments

But it's up to the governments to show that foreign capital will get a fair shake.

WHEN U. S. Commerce Secretary Sawyer and his special committee, appointed at the request of President Truman, made their report on the economic situation in Western Europe, they not only reported findings but also set forth principles in the report which can have a great bearing on the oil industry abroad.

So important were some of their conclusions WORLD OIL feels it should publish in detail those which conceivably could have an effect on American oil relations abroad.

The report is as far from a typical New Deal or so-called Fair Deal type of report as could be imagined. It is realistic to a point that could be acutely embarrassing to many present governmental bureaucrats and current as well as recent architects of the "Deals" which have actuated U. S. policy for some time.

WORLD OIL is publishing only that portion which deals with policy—policy which could influence oil happenings abroad.

The committee making this report consisted of Langbourne M. Williams, Jr., Charles R. Hook, Hawthorne Arey, J. Thomas Schneider, Henry H. Fowler and A. N. Overby, in addition to Secretary Sawyer.

In their handling of the report, American daily newspapers dealt principally with those parts of it omitted here, parts dealing with criticism of too many employes in some bureaus and suggestions for handling of American funds abroad. The entire report, covering several printed pages, is well worth preserving.

. . . businessman expects a profit

We quote from the report: In every country there was voiced an eager desire for private capital investment from America. It was generally agreed that the simple and real solution to the problem of U. S. investment abroad lies with the governments of the countries where the investments are to be made.

As distinguished from public investments by our Government, which may be on a wholly different basis, the American businessman who risks his money abroad *expects to be able to make a profit and to bring home this profit in dollars.* Furthermore, he wishes to have assurance that if he so desires he can eventually liquidate his investment just as he could if it were made in the U. S. This does not by any means indicate a wish to move in rapidly, suck the country dry, and then leave. American investors are accustomed to accepting the ordinary risks of business venture; they should not be expected to enter countries where they risk expropriation, the prohibition against conversion of earnings into dollars, special arbitrary exchange rates and other circumstances wholly beyond their control.

The much-discussed investment-guarantee proposals are not an answer nor a wise expedient. Guarantees offered by the U. S. against occurrences which are the result of policies pursued in other countries would tend to encourage rather than discourage unsound policies, and to promote the very thing which the businessman is afraid of. Realization of this fact here and abroad will stimulate and not retard the processes required to persuade private American capital to invest in other countries. One company presently holding such a guarantee expressed its carefully considered opinion that in the present state of instability and inconvertibility of currencies it is impossible from an operational standpoint to insure convertibility in a manner reasonable and satisfactory to the investor and the host government. Others expressed similar opinions. Out of approximately 600 million dollars of investment or reinvestment in Western Europe within the past four years, the investors of only 34 million dollars have obtained the available guarantees. Most of these guaranteed investments would have been made anyhow.

. . . proper atmosphere a requirement

Numerous surveys are now being made to demonstrate the patriotic necessity or international social benefits of private investment of U. S. capital abroad. American capital cannot be talked into going into other countries. If given the proper asmosphere, it will flow freely to whatever places offer the best opportunities for profit, and American businessmen are fully capable of seeking out such opportunities as well as developing them. Of the many surveys now being made dealing with the subject of private investment, many of which will merely produce a duplication of information already available, none will be of any value unless it recognizes the fundamental fact that

(The italicized words are WORLD OIL's)

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AERO SERVICE mapping crews speed the search for oil with the airborne magnetometer. Our photos aid geologic study and planning for surface work. Wherever the area, whatever the terrain, reconnaissance data comes faster from the air. To speed your next exploration, call AERO.

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Reconnaissance Data Comes Faster From the Air

Usefulness of the airborne magnetometer as a primary exploration tool in the global search for oil may now be evaluated after five years' performance.

In the hands of the Aero Service Corporation, Philadelphia, the airborne magnetometer has dovetailed neatly with the aerial mapping camera to provide a swift general look at areas of interest in all parts of the world. With these two "first tools", AERO has flown over half a million miles of oil exploration, effecting extraordinary savings of time and money.

Recently, in the first extensive oil exploration ever attempted in steaming Costa Rica, an experienced 5-man AERO team mapped 2,100 sq. mi. in 85 days, despite tropical clouds and rains. Accurate, detailed magnetic maps were delivered to the Union Oil Company in less than three months.

The first aeromagnetic survey of Africa was AERO's 24,000 sq. mi. photo mapping and airborne magnetometer coverage of Mozambique—completed in 5½ months for the Gulf Oil Company. Test drillings will be made years before they could have been undertaken without the aerial reconnaissance.

In the Bahamas, AERO mapped 83,000 sq. mi. in nine months. For plotting the airplane's position over the open waters which comprised 90% of the area, AERO applied Shoran, a precision radio-location device.

Flying of the Peace River magnetic survey covering 16,000,000 acres of northwest Canada was completed in 13 weeks by Canadian Aero Service, Ltd. A combination of boggy muskeg and heavily timbered sections would have made ground surveys slow, difficult and costly. The aerial survey cost only a few cents an acre!

In three seasons, AERO supplied the first complete photo reconnaissance of Middle East areas which are either under development or the object of new oil search. Here, AERO mappers alternated between burning ground level climate and sub-zero temperatures in their B-17 at 30,000 feet.

Geologists say that aerial exploration methods provide significant facts about regional trends and basement structures swiftly and economically, and pay for themselves many times over in the efficient guidance of the expensive and still necessary ground exploration programs.

And so the record goes. In every part of the world outside the Iron Curtain, the airborne magnetometer and aerial mapping camera are teamed to save time and money in the continuing search for oil. (*Advertisement*)

the real answer to this problem lies with the country where the investment may be made.

While businessmen of several countries indicated their fervent hope that American capital could be persuaded to move into their economy, it is true that this attitude is in many cases of a somewhat recent origin. It is no more than natural that the citizens of any country should prefer to develop the industries and resources of that country with their own capital. Nothing which we say here should indicate or imply any criticism of other governments or countries. We in the U. S. cannot and must not try to tell other governments and other peoples what they should do. We cannot ignore the factor of national pride. However, it now being clear that the only large volume of investment capital available is in the U. S., it should be possible for other countries to see the desirability of the type of private investment which continues to result in an ever-expanding and improving economy such as we have in the U. S. and other free-enterprise countries. Those countries which recognize the benefits of private investment and offer attractive opportunities will find the American businessman prepared to conduct his business in a manner mutually beneficial to himself and the country of his investment.

. . . political and economic stability

Investment capital is a commodity which will go to the highest bidder. It will go to those countries which most desire it and which, accordingly, offer the most attractive possibilities. When appropriate conditions, or so-called "good climate," prevail, investment will follow. These conditions include both political and economic stability. American businessmen still have the courage, initiative, industry and the desire to make money which has characterized their pioneer efforts in the past both at home and abroad. They will not, however, move in force to other areas in the absence of a clear indication that they are wanted. American businessmen are not undertaking to force their way into any part of the world nor do they wish or intend to establish any sort of imperialism wherever they may go.

. . . joint ventures a possibility

In England it was suggested that one possible fruitful area for exploration—assuming an attractive climate for investment—would be combined private investment ventures in which British experience with some capital would be combined with U. S. capital and experience. There is, of course, no reason why such a project, if it meets with approval among private investors in the U. S. and other countries, should not be equally feasible and attractive as between the U. S. and any other country of Western Europe.

We might well add another thought on American investment abroad. For centuries the British Empire has prospered from its world commerce and the part played by British businessmen has been recognized by their Government. They know that they could rely upon its help. That has not always been true in America. We do not wish to minimize the frequent fine assistance rendered by the Foreign Service in missions and in consulate offices abroad by men and women who are conscientiously trying to help the American businessman. However, we feel that, if American businessmen are to be urged and encouraged to enlarge their world contacts, it should be definitely indicated as a national policy that the American Government is backing them up. This will not only be a help practicably and specifically but the very fact that this policy is in effect will give an amazing psychological boost to the morale of the American businessman abroad.

Global Oil and Trouble

■ CONTINUED FROM PAGE 240

light was frequently no virtue, is downright harmful today.

More knowledge about the industry itself, as well as the working of human nature, or what is commonly called psychology, could be a help both to the expatriate employes and to the foreign nationals with whom they are dealing.

When we see some politicians trying to cure the so-called ills of big business with bigger socialism, it is clear that more knowledge about the foundations of our society is no luxury. The average oil man could do with a little more knowledge about modern capitalism.

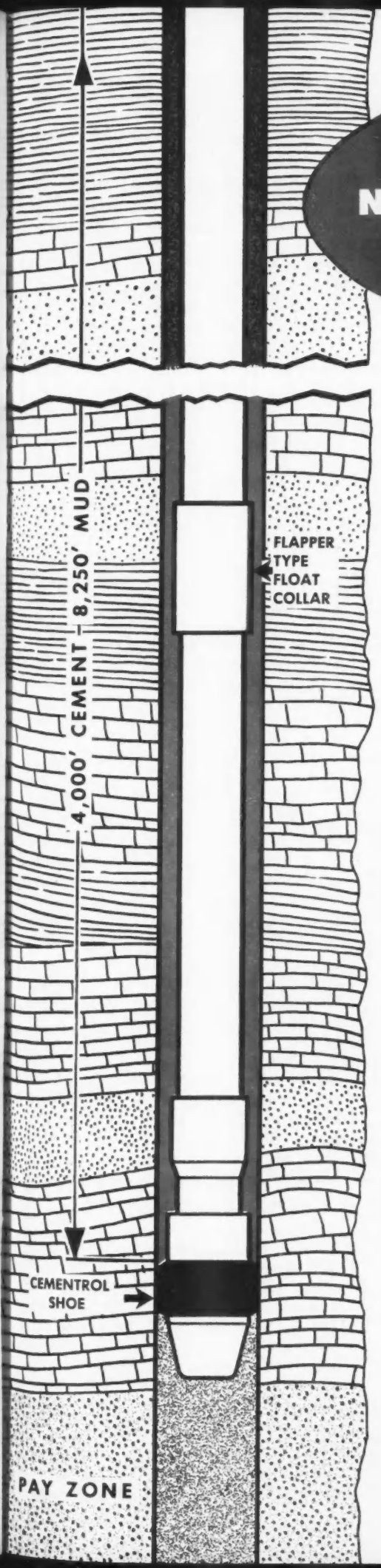
In talking about rugged individualism, freedom and competition, the industry's literature has often given him a concept that is a bit behind the times. True, it is the classic struggle for survival that built the large corporations that are here to stay. In successfully surviving murderous competition, they followed exactly the present-day philosophy of the anti-trust laws.

Let us recognize openly that bigness is nothing to be ashamed of. In modern times bigness frequently means more service to the consumer, for it is well known that only the largest concerns can indulge in the costly research which so often has meant progress. Many a 1952 oil man is often more a highly efficient servant of the public than the rugged individualist he thinks he is.

To the people abroad, the petroleum industry should become the living example of new world capitalism, a capitalism which long ago ceased to be associated with exploitation and whose emphasis now is on service. Today we are faced with a slowly growing world integration. The recently published Materials Policy Report has shown clearly that more and more the world is confronted with the necessity for careful world organization to make the best use of available resources, some of which are getting short. Without often realizing it, the private petroleum industry has pioneered toward this end. If it were up to the industry and could be done, we probably would have world prorationing today!

If present narrow, nationalistic tendencies are considered as temporary growing pains in a world that once will have to become one, the international petroleum industry is on its way to its greatest accomplishment in keeping the world's wheels humming. Oil men should not only know it. They should be proud of it.

(*Second of Two Parts*)



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NO CEMENT CONTAMINATION OF PAY !

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Cementrol

Top: Cementrol Shoe in Pack-off Position

Bottom: Flapper Type Float Collar

For Open-hole settings—as the illustration at left shows of a West Texas application—Cementrol is the surest means known for protecting exposed producing formations from cement contamination. It provides protection by the most effective, time-tested means ever devised in the oil fields—a rubber pack-off.

The Cementrol Shoe, shown above in the "pack-off" position provides an annular pack-off and an internal bridge that prevent the downward passage of slurry. In the well illustrated, 4000 feet of cement and 8250 feet of mud were successfully kept from contact with the producing zone. The Flapper-Type Float Collar used in conjunction with the Shoe permits passage of the bridging ball which actuates the Cementrol Shoe and prevents return flow of the slurry.

Thousands of successful runs of this type have made the Larkin Cementrol Shoe standard equipment for such service. Cementrol is available "... Through Your Supply Store," and your nearby Larkin representative will gladly give you any necessary assistance, including field service.

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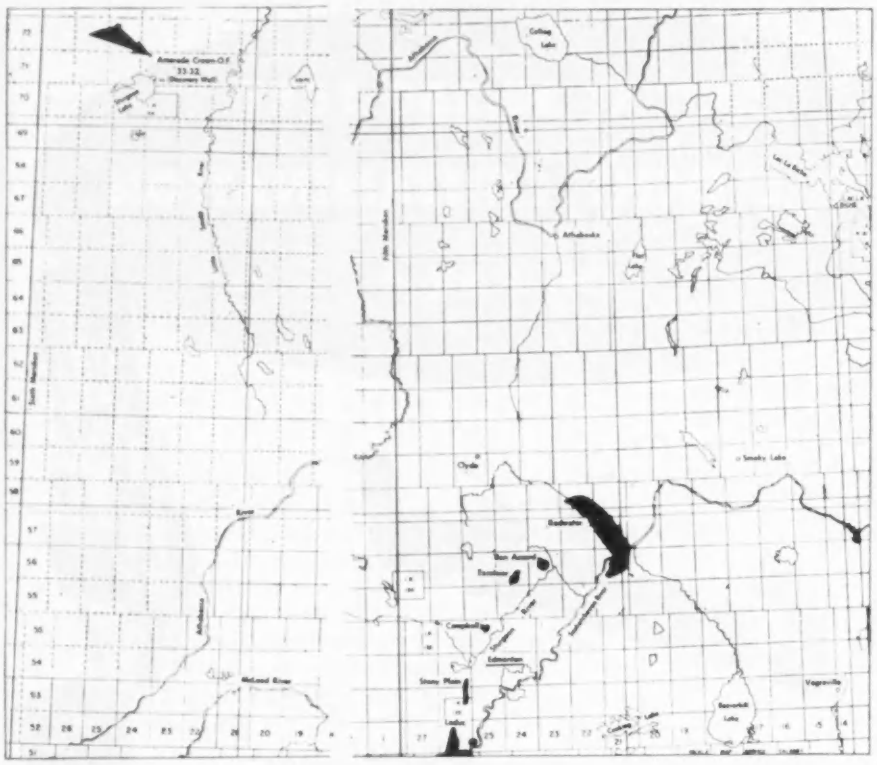

This divided map shows the location of Amerada Petroleum Corporation's reef discovery in relation to Edmonton, Alberta, and surrounding oil fields.

Tests Prove Discovery At Sturgeon Lake

Amerada continued drilling after two failures and found perseverance pays off.

By **GILBERT M. WILSON,** WORLD OIL Staff

A wildcat strike of unusual significance and importance which came in during 1952 was the discovery in August by Amerada Petroleum Corporation of prolific high-gravity reef production in a well north of Sturgeon Lake, a D3 reef producing field in the Peace River region about 185 miles northwest of Redwater.

The discovery falls about 45 miles south of the Normandville area where, in 1949, Imperial Oil Ltd. found some oil in their Normandville 1, in a 30-foot thick section of Devonian reef at 6734 feet. The new find is approximately 74 miles south of Peace River town.

The new discovery, believed to be in Devonian reef equivalent to the D-3 producing zone found at Redwater and other Alberta fields, apparently has 75 to 90 feet of water-free reef, topped at 8919 feet, or 6255 feet sub-sea. That a new discovery was made was assured in the latter part of August, when a series of drillstem tests was made between 8916 and 9015 feet.

At that time, in one of the tests—from 8955 to 8985 feet—gas at a quarter-million foot daily rate, hit the surface in eight minutes and 35-gravity oil came to the surface in an hour and 40 minutes. After flowing for 30 minutes, the well was shut in for an hour and, on pulling drill pipe, recovery was found to be 1440 feet of oil and 90 feet of oil cut mud.

Hydrostatic pressure was 5200 pounds, flowing pressure was 550 pounds, building up to 1400 pounds and shut-in pressure was 3900 pounds. Total depth of the hole was 9015 feet.

Production Data

Seven-inch pipe was cemented at 8993 feet. Following a period during which a water shut-off problem was being combatted, the well, in the latter part of October, was given a potential test. Through perforations at 8918-8976, during an eight-hour test, the well flowed 36-gravity sweet crude at a 700 barrel a day rate through 5/16-inch choke. Gas oil ratio was 640. The well is now shut in, but the discovery is regarded as the most prolific oil find made to date in the Peace River region, noted as a gas producing area.

The discovery is the third hole drilled by the company in this area. One, drilled 18 miles northwestward, was a dry hole; a second, three-fourths-mile north of the discovery, drilled to a total depth of 10,278 feet, found a thick section of Devonian reef, but it was water bearing. Discovery of the thick reef caused Amerada to move up dip and make another test; the present discovery bearing testimony to the accuracy of the belief that it might be oil bearing.

The pay section is a buff, dolomitic reef. It carried water when drilling was stopped at 9015 feet. Formations drilled—shales, sands and limestones—are typical of the Peace River section. There is no pipe line in the area and doubtless crude will have to be trucked out for some time.

Amerada holds extensive acreage in the vicinity of the discovery. Other companies holding acreage in the general area include Canadian Gulf Oil Co., Hudson's Bay Oil and Gas Company, Ltd., Scurry Oils, Ltd., Imperial Oil, Seaboard Oil Co. and Standard Oil Company (California). Further development work must be done before extent of the find can be evaluated. Amerada currently is running two geophysical crews in the area and other companies also are actively prospecting the region.

Drilling and Completion Data

Drilling was done by a drilling contractor. Drill string used was four and one-half-inch drill pipe with about 15 six and one-eighth-inch drill collars. About 80 bits, including core heads, were used in the discovery well. Casing program included 13⅜-inch surface pipe set at 600 feet and cemented to the surface. Hole then was reduced to nine and seven-eighths-inch and drilled through the

• CONTINUED ON PAGE 248

Gouging out a Bolivian Mountain
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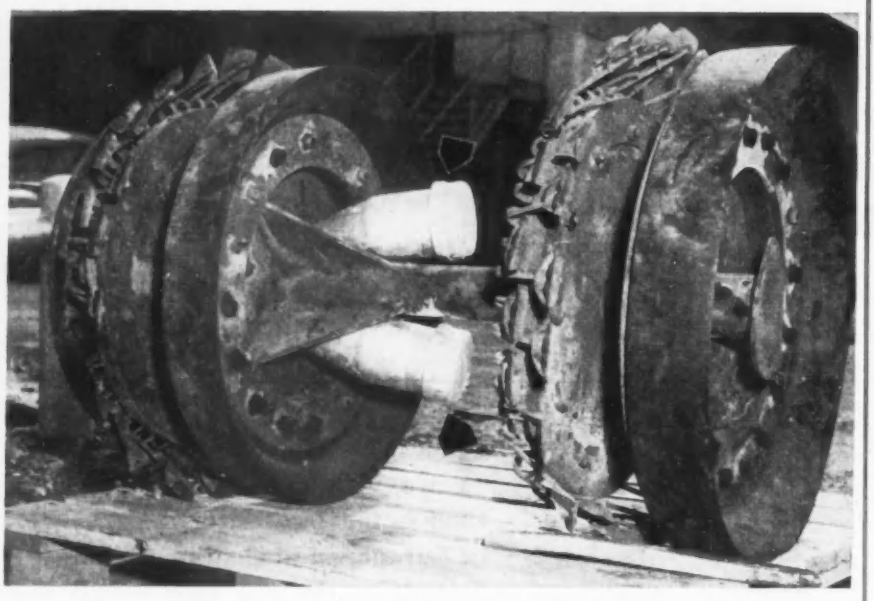


This champagne cargo consisting of two bottles was put at head of the first tender of oil to be pumped through Venezuela's Lightline. Containers (marked by arrows) in which bottles were placed consisted of a swage nipple with two pipe caps, the smaller one brazed to iron scraper holder disc. Bottles arrived at Shell Group Cardon refinery in three and a half days. While not ch.lled to generally accepted temperature, contents provided a christening libation for reception committee.

Champagne via Pipe Line

THE long-established custom of christening boats by splashing a bottle of champagne across their bows has spilled over into the pipe line business. And in a most unusual operation. In Venezuela recently, the 30-inch, 150-mile, 230,000-barrel-a-day pipe line from Palmarejo-to-Paraguana Peninsula was completed. Importance of the line and the effort involved in its construction called for some sort of ceremony.

The call was answered and several bottles of champagne were pumped through the line ahead of the cleaning plug during starting-up operations. The line, officially called "Lightline" because it handles relatively light gravity crudes, is operated by Shell Caribbean Petroleum Company, the major owner.

Deilmann, Spanish Firm Sign Exploration Pact

C. Deilmann of Bentheim (Emsland), German crude producer and mine owner, has signed an agreement at Madrid under which the firm of C. Deilmann Bergbau GmbH. entered into partnership with the Spanish Cia. Espanola de Petroles Scientificas Investigaciones to seek oil in the Ebro basin, south of Bilbao.

German geologists, geophysical crew and drilling crew will be sent to Spain. Preliminary investigations were scheduled to get under way in November. This year a German deep drilling rig will be sent to Spain.

An agreement between a Spanish mining company and an American group covering the Logrono-Saragossa area exploration activities recently was reported. The CIEPSA-Deilmann pact now opens prospects for German-Spanish cooperation. German experts who have studied Ebro valley conditions believe there is little hope of finding large oil fields in Spain because of complicated geological structures. However, they think there are good chances of discovering medium-sized commercial deposits.

CIEPSA is the largest Spanish privately-owned oil company. It owns a crude refinery at Teneriffa (Canarian Islands) and has a share in Venezuela production.

The firm of C. Deilmann, which has an interest in the German oil fields of Georgsdorf, Ruehlertwist, Sheerhorn, and Weingarten, and gas fields of Bentheim, Frenswegen and Itterbeck, has been conducting drilling activities in Central Spain for the past two years in behalf of the brown coal mines of Calvo Sotela.

Sturgeon Lake

■ CONTINUED FROM PAGE 246

pay section. Seven-inch casing was then run and cemented up to a point above the fluid-bearing horizons in the Cretaceous. Pipe was selectively gun perforated opposite the pay zone. The well was swabbed in.

Natural muds were used to the top of the Mississippian at around 5500 feet; a high pH mud being used from there on down. No circulation or mud control problems were encountered and there was no unusual danger of blowouts. In the discovery well, no unusual fishing jobs were encountered but in some other wells in the area, fishing jobs, probably due to key-seating, have been experienced in certain formations.

Rig used on this particular well was a standard derrick with drawworks capable of drilling to 10,000 to 11,000 feet. Propane fuel was used. Two mud pumps, one for circulating and one for mud mixing, were used. Mud ditches were excavated. The well was equipped with two blowout preventers. No special equipment, other than housing for winter operations, was employed.

Drilling water was obtained from a 270-foot water well. Nearest towns are Grand Prairie, population about 2300, about 52 miles to the west and Valleyview, population 1200, 12 miles to the southeast. Nearest large supply or machine shop center is Edmonton, about 325 miles distant. Roads in the area are graded and/or gravelled. Most of the area in the vicinity of the well is muskeg and is a burned-over area, with second growth of poplar and spruce. Crews generally live in trailers near well or in homes or hotels in nearby towns.

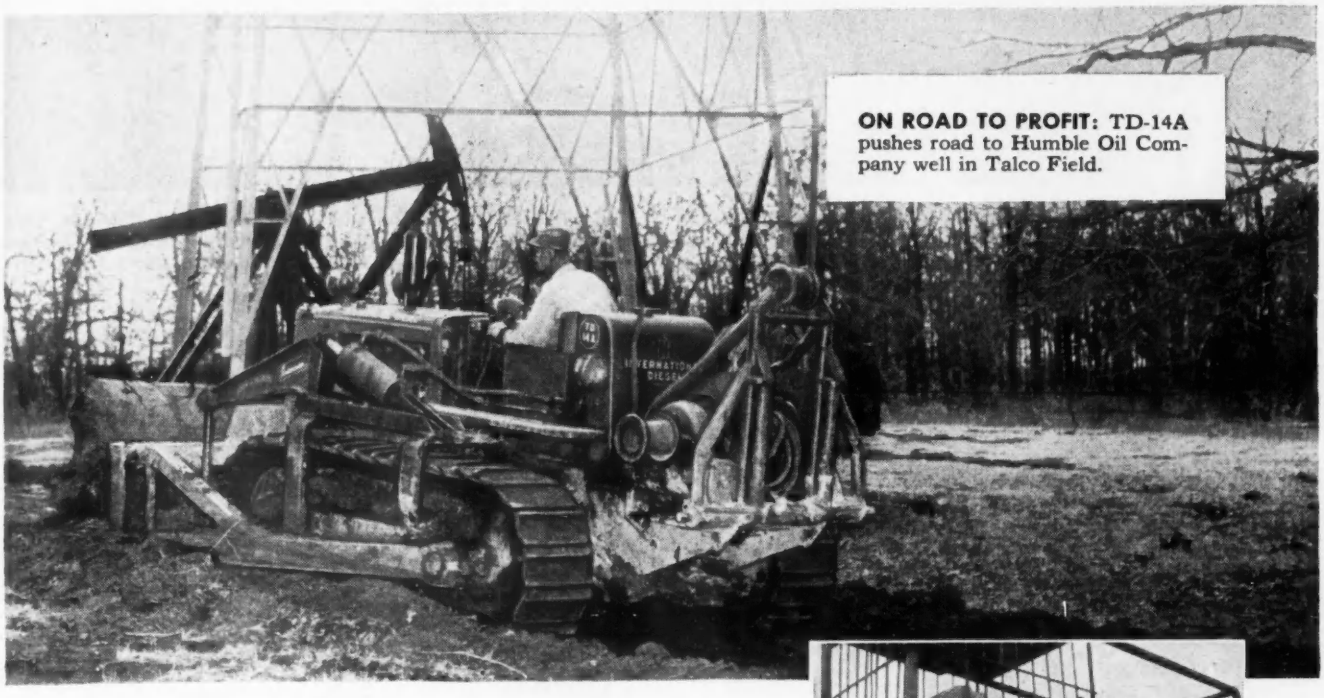
German Wildcat Flowing; Extension Well Is Started

Preussag's wildcat Lehrte 12 is yielding a daily flow of 18 barrels from a depth of 3937 feet in the lower part of the Cornbrash sandstone. The crude is being moved by tank wagons.

Preussag has begun an extension well, Lehrte 13, about 656 feet northeast of Lehrte 12.

Production tests in the wildcat Vorhop 5c, also belonging to Preussag, have not yet been completed. After erection of a derrick, the hole will be cleaned.

Discovers Goldmine in Oilfields



ON ROAD TO PROFIT: TD-14A pushes road to Humble Oil Company well in Talco Field.

Rugged, Reliable Internationals Prove Real Money-Makers for Texas Contractor

John D. Wright, oil field contractor, Talco, Texas, bought his first International in 1941. Since then he has used nothing else for oil field preparation.

There is one big reason why: he *makes more money*. Here's the way he puts it:

"I had one TD-14 I used for over five years. This crawler gave me better service and made me more money than you could ever expect from any tractor its size.

"I've never seen a tractor that could out work my Internationals. I now have three TD-24s for land clearing and heavy dirt jobs and a TD-14A for special oil field work.

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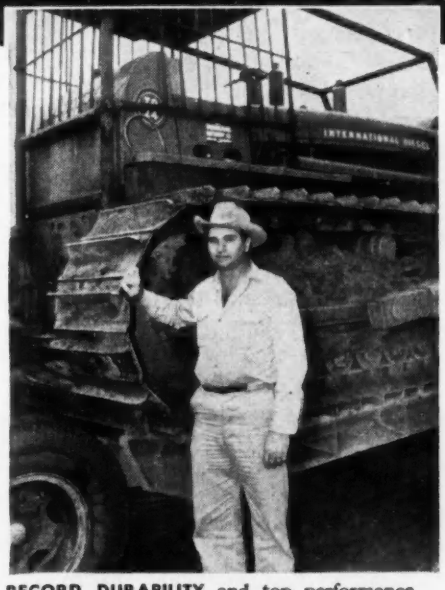

RECORD DURABILITY and top performance keeps contractor J. D. Wright sold on Internationals. Here he is beside his newest addition, a rugged TD-24—the most powerful crawler on the market.

IT'S INTERNATIONAL all the way with Mr. Wright. Here one of his TD-24s is moved to new job location on trailer pulled by IH L-190 series truck tractor.

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Of World Oil Men

Foreign visitors to the November meeting of the New York Chapter of Nomads were (left to right): R. W. Parker, California-Texas Oil Company, Australia; Granville Parker, The Texas Company, Bogota, Colombia; E. C. Hendrix, International General Electric Company, Caracas, Venezuela; Dennis Slatford, Trinidad Oilfield Service, Ltd., Trinidad, B.W.I.; George Lockett, Mene Grande Oil Company, Maracaibo, Venezuela; Carlos Bejarano, Motores, S. A., Bogota, Colombia, and J. Feger, SNPA, Paris, France.

J. B. NEWLAND, formerly with Imperial Oil Limited, has been named senior geologist of Trafford & Associates, engineering and management consultants, Calgary, Alta., and K. R. STOUT, former Shell Oil Group exploitation engineer, has been made a junior associate. Newland received his B.A. degree in geology from Iowa State University in 1929. He then joined the Cities Service Company as sub-surface geologist in the Permian Basin of West Texas and New Mexico. During the war, he was in the meterological service of the army in Canada and the U. S. In 1945 he joined Imperial. Stout, a graduate from the University of Birmingham, England, in 1945 began his career with D'Arcy Exploration Company. He later joined the Shell Oil Group for service in England, Holland, Trinidad and Canada.

WILLIAM C. KNEALE, with The Texas Company in Texas and Oklahoma for 30 years, has been appointed general manager of Devon-Leduc Oils, Ltd., Toronto, Canada.

•

LOUIS DESJARDINS, Houston photogeologist, has moved to Brazil, where he has been appointed by Conselho Nacional do Petroleo to have charge of Brazil's photogeology oil development program. He had previously spent several years in Venezuela in a similar position with Creole Petroleum Corp.

Louis Desjardins

•

Recently-elected 1953 directors for the Alberta Division of the Canadian Petroleum Association are, standing left to right, Paul L. Kartzke, Shell Oil Company; G. E. Dunlap, Sun Oil Company; A. G. Bailey, Bailey Selburn Oil & Gas Ltd.; C. U. Daniels, Royalite Oil Co. Ltd.; E. H. Vallet, Triad Oil Company Ltd.; and B. Gillespie, British American Oil Company Ltd. Seated left to right are T. W. G. Thomson, Texaco Exploration Company; G. L. Knox, The California Standard Company; and W. D. C. MacKenzie, Imperial Oil Ltd. Directors missing from the photograph are W. A. Weir, Oilwell Supply Company; Ralph Will, Security Freehold Petroleums Ltd.; R. C. Brown, Hudson Bay Oil & Gas Company Ltd.; S. P. King, Albercan Oil Corporation; E. D. Loughney, Canadian Gulf Oil Company; and N. W. Nichols, Great Plains Development Company of Canada.

C. THEODORE JONES, senior marketer in charge of marketing in Europe, Africa and the Near East for Tide Water Associated Oil Company, has retired after more than 27 years' service, and JOHN FAXON, former senior marketing assistant in the Industrial Sales Section of Tide Water's New York office, has been named his successor.

Jones joined Tide Water in 1925 as supervisor of marketing for Europe, Africa and Near East. In 1940 he was assigned to Japan as vice president and director of the Mitsubishi Oil Company. He returned to the U. S. as special representative with the export department of Tide Water Associated's Western Division at San Francisco. Three years later, he resumed his marketing activities in Europe, Africa and the Near East, with headquarters in New York.

Faxon, who joined Tide Water Associated in 1934 in its Westbury, Long Island, bulk plant, was transferred seven years later to the New York office. He was appointed senior marketing assistant in 1947.

•

JOHN A. FULLER, president of the Shawinigan Water and Power Company, has been named to The British American Oil Company Limited board of directors. Fuller is also president of Quebec Power Company and St. Maurice Power Corporation. He is a vice president and director of Shawinigan Chemicals Limited and of Canadian Resins and Chemicals Limited, and a director of Montreal Trust Company and Rolls Royce of Canada Limited.

Funny Thing—
he really had something!

"The miracle of the century!" he would rant. "The most sensational discovery of all time! Positively guaranteed to restore natural color to the hair, free you from the crippling clutches of rheumatism, break the most stubborn fever, cure coughs, colds, backache and liver complaints!

"Now to you, my friends, as a special introductory offer, this bottle, which usually sells for $15 and more is yours . . . not for $10, not for $5, but for the amazing low price of . . ."

Pure hokum, of course. For little did the medicine man realize, when he bottled crude oil out of the ground, that his most extravagant claims could not do justice to the real capabilities of this "liquid gold." He really had something—and didn't know it.

His "Rock Oil Nostrum" really *was* the miracle of the century!

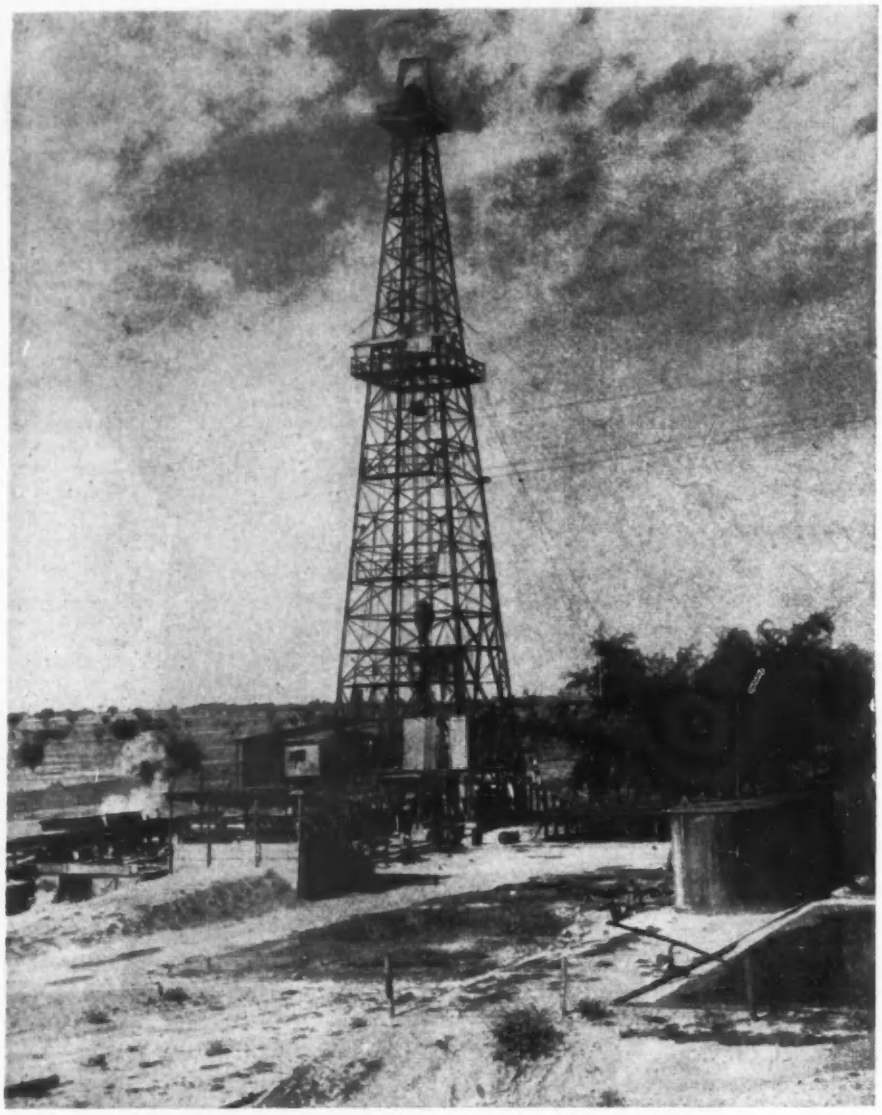
From his giant economy-sized bottle have since flowed the oil and gasolene that made the automobile possible . . . the lubes and greases that have enabled machines to take over man's back-breaking jobs. From that miraculous bottle have come asphalt, insecticides, wax, plastics, literally hundreds of useful products—even drugs "to cure coughs, colds, backache and liver complaints!"

Cities Service, an oldster in the oil business, has been responsible for many of these petroleum miracles. It is pouring more products out of that bottomless bottle every day. The men in its Miracle Department (petro-chemists, they're called), say that oil has just been flexing its muscles—we haven't even begun to see all it can do.

To put it very simply: You and I live better, more comfortably, because petroleum was discovered. And that's no hokum!

CITIES SERVICE

Quality Petroleum Products



This is the Pakistan Petroleum Limited Chak Naurang Well 1, situated near Chakwal, Pakistan, in the Punjab region, which has found an oil pool of undetermined size at 7700 feet. After an acid treatment, the well flowed about 200 barrels of crude in 24 hours from the limestone formation. The oil contains a large proportion of asphalt and small quantities of light oils.

A WORLD of OIL

By DON KLIEWER, WORLD OIL Staff

BAHRAIN: Bahrein Petroleum Company Limited is submitting to a new Bahrain tax law under which a 50-50 income tax is levied on crude-producing companies at Bahrain. The tax applies only to net income from production and sale of Bahrain crude beginning January 1, 1952.

AFRICA: D'Arcy Exploration Company, the Anglo-Iranian Oil Company, Ltd., prospecting subsidiary will begin, in conjunction with the Royal Dutch Shell, a comprehensive program of geological and geophysical surveys in the eastern part of the country.

CANADA: A further reduction in compensation rates of 50 cents per $100 of payroll will be in effect this year for Canadian drilling contractors. The Canadian Association of Oilwell Drilling Contractors believes the reductions result from extensive safety work and the education program being conducted by the association in conjunction with the Workmen's Compensation Board, the University of Alberta and the Western Canada Petroleum Association. An average of about 1½ wells per day is being drilled in Saskatchewan and new discoveries are averaging two a month. There are about 300 producing wells in Saskatchewan now . . . Western Canada Petroleum Association, sponsored by oil companies and firms affiliated with the oil industry, has extended its activities and recently passed a resolution changing its name to the Canadian Petroleum Association. The Federal Power Commission at Washington, D. C., has rejected motions from its staff that it deny pipe line applications involving import of Canadian natural gas . . . Hearings at Washington will be resumed February 16.

AUSTRIA: The Austrian Union of Labor (Gewerkschaftsbund) has demanded a 5 percent wage boost for oil workers employed by the Soviet Mineral Oil Administration and by the few remaining independent (though tightly Soviet-controlled) Western oil firms. No reply has been received . . . Conversion of coal-consuming industrial power plants has come to a standstill during the past six months for two reasons—world market prices on coal dropped and SMOA raised the fuel oil retail price. Soviets of late, however, cut their price hike on fuel oil in half.

QATAR: Exploration is scheduled to get under way immediately by Shell Petroleum Company on its recently-granted Persian Gulf underwater oil concession.

WEST GERMANY: Gewerkschaft Elwerath's wildcat Stockstadt 1, located on a structure discovered by reflexion seismic methods south of Wolfskehlen (Upper Rhine valley) found heavy oil traces in the Pechelbronn beds—the first time oil bearing Pechelbronn beds of the Oligocene have been encountered as far north in the Rhine valley . . . C. Dielmann Bergbau GmbH. has set a new drilling record in its deep well Scheerhorn 50. Recently, a modern torque converter rig made 2050 feet in 24 hours, with the bit being changed once . . . The Oil Committee of the OEEC (MSA) OK'd an increase in the intake capacity of Ruhrbau GmbH. refinery of Muelheim (Ruhr) from about 700,000 barrels to approximately 1,400,000 barrels a year. In the AEV (Association of German Crude Producers and Refiners) Ruhrbau had been listed with an intake capacity of 1,042,382 barrels a year of Arabian American Oil Company crude.

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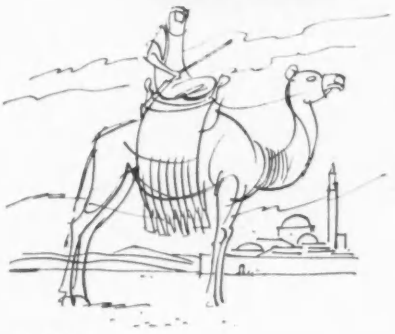

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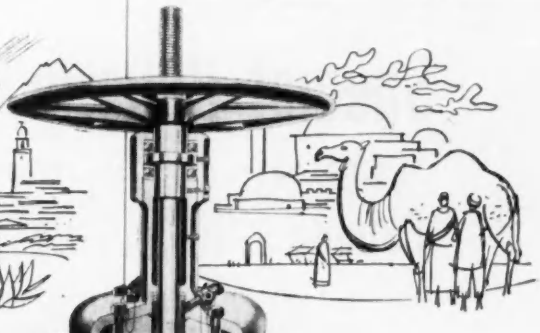

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Key speakers at the Far East Command Area Petroleum Office Conference held at Tokyo were, left to right, Major General Joseph P. Sullivan, who was recently assigned to the Command as Quartermaster and Area Petroleum Officer; Rear Admiral B. B. Biggs, former chairman of the Munitions Board Joint Petroleum Committee and present commander of Service Squadron 3; Brigadier General Merrill D. Burnside, director of material, Far East Air Forces; and Rear Admiral Wallis F. Petersen, commanding officer, Military Sea Transportation Service, Western Pacific, operators of the military tanker fleet. Purpose of the conference was to solve problems of handling petroleum products.

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that imports of gasoline into West Germany are no longer required, except in cases of emergency where a sudden peak demand develops. . . . Rumor that a German company would be established to import Iranian crude has been denied by the Economics Ministry, which said the present trade pact with Iran provides for no crude imports and that, except within the framework of the trade agreement, there is no possibility of licensing imports. . . . Released for imports of Venezuela crude (Tia Juana) is $1,240,000 in MSA funds.

Gewerkschaft Vereinigte Borgholzhausen, a drilling contractor firm, has taken up crude producing. It drilled wells Cremine 2 and 3 in Eddesse-Nord oil field and shares the output with Gewerkschaft Hannover-Erdoel. . . . An article authored by Dr. H. Kroll of the Economics Ministry announced that a committee would be formed which is to study the possibility of trade with East Germany. . . . In view of the pending lawsuit between the U. S. Government and several foreign-operating oil companies, the Mineral Oil Department will hereafter add this clause to import and payment licenses for crude from Saudi Arabia: "In the case of a retroactive reduction of prices for the MSA, such reduced prices will also be valid for the present purchase."

THE NETHERLANDS: Recently, the well Berkel, owned by Nederlandse Aardolie Mij. and situated north of Rotterdam, struck an oil-bearing formation. Work on the well was discontinued for technical reasons, and a follow-up well has been drilled a half mile southeast of the first well . . . Shortly, an exploration well will be drilled on the outskirts of The Hague, near Rijswijk.

MEXICO: A new oil well was reportedly brought in in the Vera Cruz basin, which lies between Porto Rico and Isthmus producing areas. While no production estimate has been given, oil was reportedly found at levels of 5477-5503 feet, 6428-6504 feet, and 7563-7635 feet . . . If this reported discovery at Angostura proves up, it will have a major significance since it is in the area under development in the Papaloapan project (Mexico's TVA) and because the region has good transportation facilities.

PUERTO RICO: Cosden Petroleum Corporation of Big Spring, Texas, has been offered a loan of

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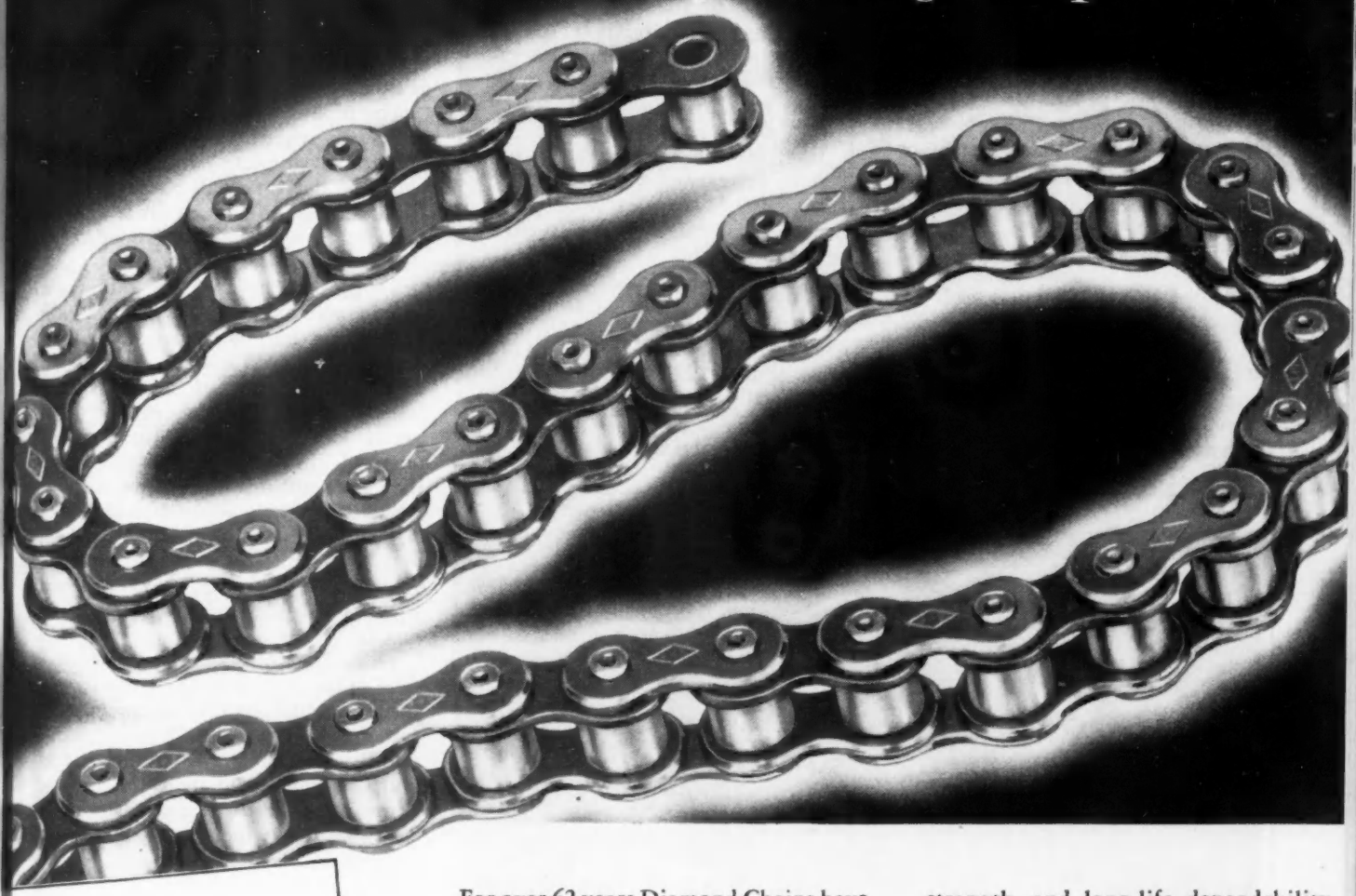

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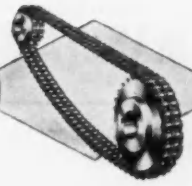
DIAMOND  **ROLLER CHAINS**

$3¼ million dollars by the Puerto Rican Development Bank to complete financial arrangements for the erection of a refinery—contingent upon the economic promise, however, said bank officials.

CZECHOSLOVAKIA: Workers of the Skoda machine factory have been cautioned that tardy delivery of diesel engines will cause the Soviet Union the loss of many hundred thousands barrels of oil . . . Consequently, engines on order have to be produced ahead of schedule to provide a "security" period during their rail transport . . . Another factory, the Komotau pipe factory (formerly German Mannesmann) has received orders for four-inch line pipe and one large order of knee joints for pipe lines . . . The Koenigsfeld machine factory of Bruenn recently delivered a complete cracking system to the Soviets, the tanks of which measured 100 feet in length.

ROUMANIA: The country's first night hospital for oil field workers has opened at Moreni, and officials said sick workers will receive two warm meals and one cold meal daily but will continue to work during their treatment and recuperation. Transfer to the hospital is restricted, and workers are not allowed to consult other than oil field doctors . . . And, incidentally, one room in the hospital is reserved for political training . . . Vienna says the nation's 1952 crude yield was 17 percent more than in 1951—a statement that means little since no figures were cited . . . The record year was reached in 1943 and has not been equalled despite Sov-Rum-Petrol's concerted drive to boost production. That failure is blamed on the $30 million loss in machinery which followed the Soviet "liberation."

Slick Trick

British Government observers, scientists and tanker masters have just completed a mission of stalking oil slicks on the high seas off southwest England—all in the interest of combating the growing menace of oil pollution in harbors and along beaches surrounding the United Kingdom.

Aboard the 134-ton yacht Gay Caprice, this oil patrol has gathered scientific data on what happens to the patches of oil washings discharged at sea as part of tank-cleaning operations. Data consisting of the flow rate, resistance of oil to the sea, and its tendency to coagulate, disintegrate or sink has been forwarded to a committee which will consider what practical steps can be taken to clear up the matter.

1050-Foot Underwater Line Is Completed

An underwater oil pipe line measuring 1050 feet long and welded into one piece was recently completed by Foster Wheeler Corporation for Standard Vacuum Refining Company of South Africa (Pty:) Ltd.

The pipe was sunk in Durban Harbor near where Foster Wheeler is building a complete refinery for Stanvac. The new line will supply fuel oil from terminal facilities to a harbor terminal for ship bunker unloading at the main city docks.

To protect the new fuel pipe from marine teredos, it was wrapped with antimarine and corrosion insulation and then covered with wood slats for mechanical protection during installation. The slats are expected to break loose in time. Although the nominal life of the pipe is 20 years, these precautions are expected to keep it in service about 50 years.

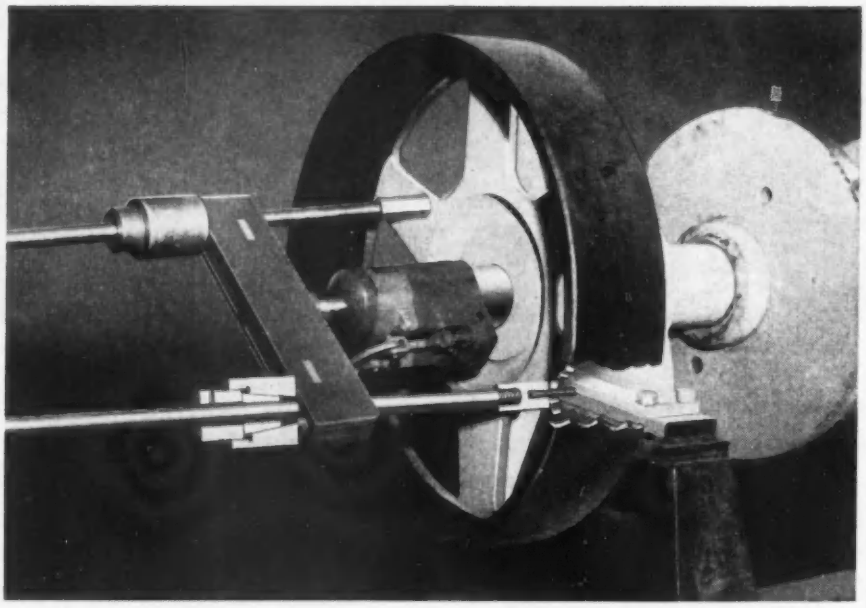
The pipe was lowered into a five-foot trench, at an average depth of 42 feet. Twelve rafts, each equipped with a small winch, were used to sink it.

Flexibility of the long, one-piece steel tube as it stretched across the surface of the surging water complicated the task of the rigging crews slightly. But the whole sinking operation was completed in less than four hours in order to permit resumption of shipping, which had been suspended during the operation.

The Stanvac plant will have a design capacity of approximately 15,600 barrels of crude per day. A combination-type unit, it will combine fluid catalytic cracking with crude distillation and thermal reforming functions. End products, in addition to motor gasoline, will include power and lighting kerosenes, automotive and industrial Diesel fuels, and light and heavy grades of fuel oil.

West Germany's Drilling Reaches New Record High

West Germany's deep drilling activities continued upward in September. Footage for that month of 150,069 feet was a new peak which exceeded August by almost 5250 feet.



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June, the previous record drilling month, was surpassed by 656 feet.

During the first nine months of 1952, a total of 1,186,812 feet was drilled. Apparently, the originally planned total of 1,706,460 feet for 1952 was not reached, but final figures will show about a 25 percent rise from 1951.

In September, 36 wells were successful, including wildcat Lehrte 12, which opened up a new oil field, and extension wells Hemmelte-West 13 and 14. At Lingen, wells L 146 and L 149 found gas. Both Lingen wells are situated on the highest part of the Dalum high block where a free gas cap has been proved in the Valendis.

The increase in drilling activities from August resulted from the extension wells—2703 feet in the service well Emlichheim 503 and 4567 feet in shallow core holes, chiefly at Baden and near Engelbostel (Hanover).

September Drilling

Well Type	Footage
Wildcats	33,688
Extension wells	37,730
Development wells	74,888
Service wells	2,703
Total	149,009

Assam Oil Company India Exploration Is Reported

A deep oil test in the Brahmaputra Valley, Assam, India, will begin drilling soon, the Assam Oil Company, Ltd., has announced in Digboi.

The well will be situated near the Assam Railway about 1¾ miles north of Nahorkatiya Station, 13 miles south of Tinsukia, in the northeast corner of the state. The test is scheduled to 15,000 feet.

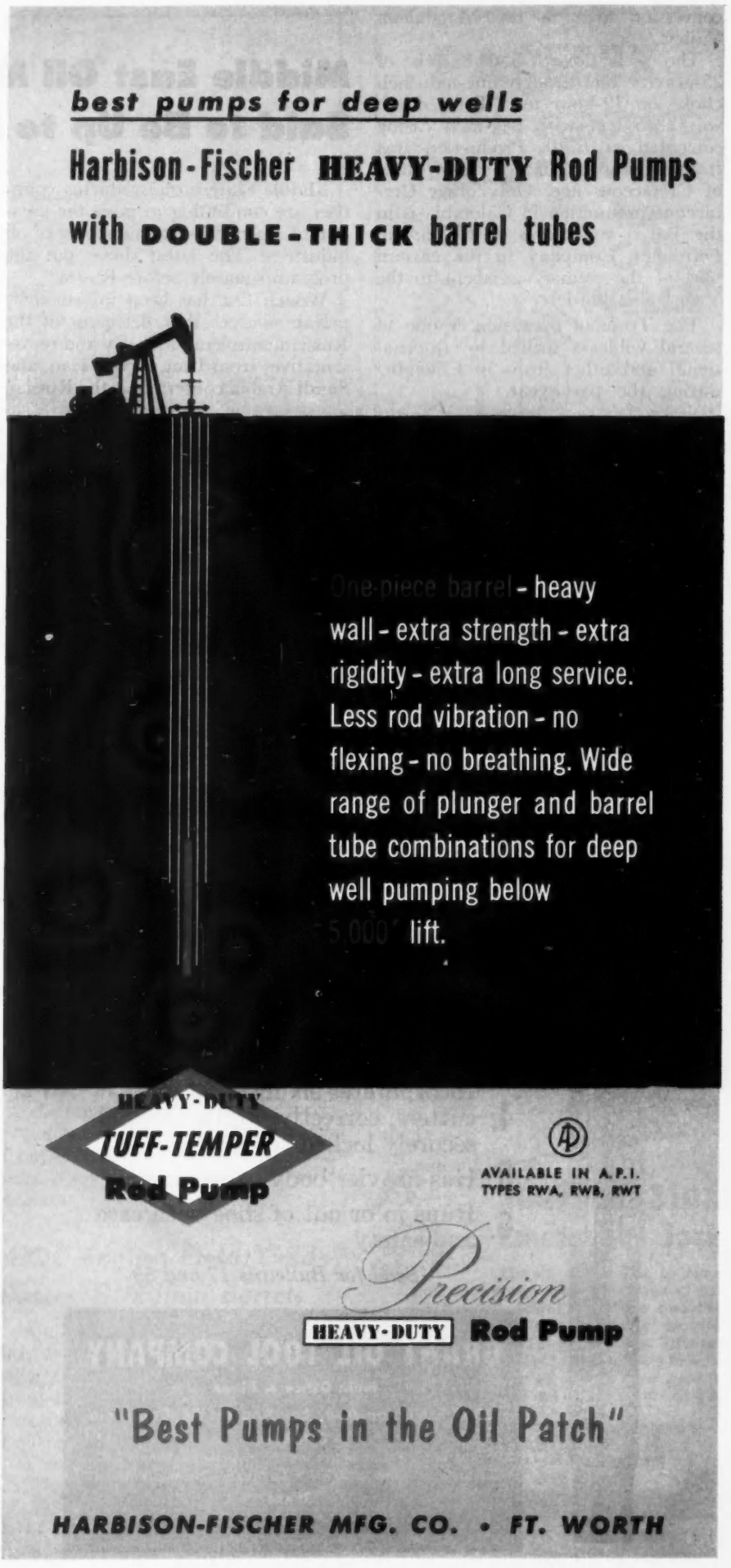
Drilling of this test is the result of intensive exploration throughout 8000 square miles of the Brahmaputra Valley and adjoining hills.

Assam Oil has another test drilling at Nichuguard, about ten miles from Dimapur, in the Naga Hills of Assam. This well is below 4000 feet, but has not given any sign of oil production.

Test wells recently drilled by the company at Tiru Hills and Barsilla, also in Assam, failed to find oil.

Colombia Has Strike North Of Former De Mares Area

International Petroleum Company of Colombia announced a discovery in its Totumal wildcat, about 75 miles north of the former De Mares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concession area in the Magdalena Valley.

The well flowed 550 barrels of 25-gravity oil through one-half-inch choke on 12-hour test. Total depth was 7215 feet with 8⅝-inch casing cemented at 6740. Production was from fractured limestone and shale of Cretaceous age. Only other Cretaceous production in Colombia is in the Barco concession of Colombian Petroleum Company in the eastern part of the country adjacent to the Venezuelan border.

The Totumal operation is one of several wildcats drilled by International and other firms in Colombia during the past year.

Middle East Oil Monopoly Said to Be Up to Russia

Middle Eastern oil-producing countries are continuing to push the creation of a general state monopoly of oil industries. The latest shove put the program squarely before Russia.

WORLD OIL has been informed by private sources that delegates of the Russian petroleum industry and representatives from Iran, Egypt, Iraq, and Saudi Arabia conferred at the Russian legation office at Tirana, Albania, on November 28.

Sulemain Hashir, representative of the Egyptian Ministry for Industry, said any action toward the monopoly would be impossible unless Russia guaranteed Arabian countries that it would take the entire Middle East oil output in exchange for foodstuffs, industrial and military equipment and machinery with which to develop local crude resources.

Identical views were expressed by the Iraqi and Saudi Arabian representatives. But Colonel Sokoloff, Russian delegation chairman, refused to consider such an arrangement.

However, another conference between Sokoloff and Hussein Makki, the Iranian deputy premier and one of his countries most powerful men, was reportedly arranged by Makki's representative to the Tirana meeting so a proposal that Iran trade its oil to Russia for wheat and textiles could be discussed.

BCO Quits Venezuela, Sells Concession, Wells

A new group of American independents including C. W. Murchison, Dallas; Cecil V. Hagen, Houston; G. L. Ohrstrom Associates and Roy B. Kelly of Washington, D. C., has purchased the concession and oil producing properties of British Controlled Oilfields in Venezuela and plans to operate the properties as Talon Petroleum, C.A.

BCO, the smallest Venezuelan producer, has experienced a gradual decline in output from its three fields in the Lake Maracaibo over the past few years and had been seeking a partner or a purchaser of its concession for some time. The company's production in 1952 averaged 943 barrels daily from the El Mene, Hombre Pintado and Media fields. BCO's concession totaled approximately 9000 acres. The company applied for new concession late last year from the government, though no additional concessions have been granted to operators so far.

BCO's desire to relinquish its Venezuelan operations were due to rising costs over the recent years and a lack of new oil discoveries to offset its declining output. Biggest factor in the company's bleak financial picture was mounting labor costs.

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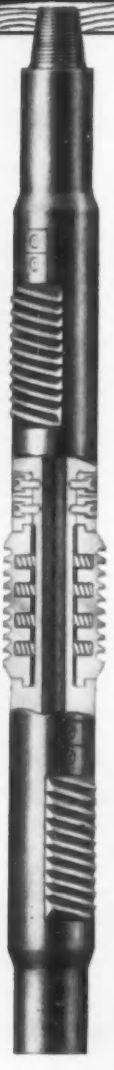

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Dotted line shows possible pipe line route from Fosterton area to Regina.

Socony-Vacuum Is Considering Fosterton-Regina Pipe Line

A PIPE line to deliver crude from the Fosterton area of southwestern Saskatchewan to Regina, capital of the province, a distance of about 175 miles, may be constructed by Socony-Vacuum Oil Company if an assured production of at least 10,000 barrels per day can be developed in a five field area recently discovered by the company.

B. Brewster Jennings, president of the company, in a speech delivered recently before the New York Society of Security Analysts, New York, said his company, up to mid-November, had discovered oil in five separate fields in an area some 20 to 30 miles west of Swift Current and, currently has five drilling rigs operating developing and evaluating the finds.

Fosterton field, first of the discoveries, brought in in January, 1952, now has nine producing wells, he said, and is only partially developed. Drilling is continuing also in the other four areas;

- Midway, which at mid-November had two producers.
- Cantuar, with eight producers.
- Success, with three producers.
- Beverly, with one producer up to that time.

The fields fall within a million-acre block in which Socony-Vacuum has one-half interest. Depth to the producing horizon, the Lower Cretaceous sandstone, in this area ranges from 3100 to 3300 feet. Oil is of medium gravity, ranging from 22 to 24 degrees.

AIOC English Field Yield Passes 5 Million Barrels

Anglo-Iranian Oil Company's English fields have produced more than 5,120,000 barrels of oil. Production from these fields, situated near Eakring, Nottinghamshire and Formby in Lancashire, began in 1938.

The first year's production was only 730 barrels. Peak annual production of 823,937 barrels was reached in 1943. Since the annual production has been approximately 365,350 barrels.

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News of Men in the Industry

R. G. Follis, chairman of the board of Standard Oil Company of California, was reelected a board member of the National Industrial Conference Board in December. He has been a member of the board since 1946.

•

Sam C. Oliphant, assistant division production superintendent of Stanolind Oil and Gas Company, has joined Tennessee Production Company as director of geology and petroleum engineering. A graduate in petroleum engineering from the University of Texas, Oliphant had been with Stanolind doing petroleum engineering and production work, for the past 12 years.

•

Albert E. Thiele, vice president and member of the executive committee of Maracaibo Oil Exploration Corporation, has been named a member of the newly created board for development of New York University.

•

F. D. Bode was named division geologist of the Rocky Mountain area for The Texas Company, Producing department. Bode received a Ph.D. from California Institute of Technology where he taught for several years. He also engaged in foreign service for Standard Oil Company of California before joining Texaco in 1942. He became senior geologist in Los Angeles in 1950.

•

Lloyd W. Johnson has been appointed division office manager for Stanolind Oil and Gas Company's Rocky Mountain division, replacing **J. D. Thomas.** Johnson joined Stanolind in 1933 after graduation from the University of Oklahoma, and for the past six years has been employed in supervisory capacity in the Industrial Relations and Administrative departments at Tulsa. Thomas returns to Tulsa to resume his position as assistant to the comptroller. He had been on temporary assignment as division office manager at Casper, Wyo.

•

H. E. Christensen was promoted to assistant division manager of the Rocky Mountain division by The Texas Company, Producing department. He is a graduate of the University of Colorado and joined Texaco as instrument man at Ardmore, Okla., in 1928. He became division geologist in 1943.

•

William G. Dudley, formerly of Houston, has been promoted to project leader in the electrochemical engineering department of The Dow Chemical Company's Texas division at Freeport. Dudley, who joined Dow in 1951, was promoted from the position of research and development engineer. He was graduated from Rice Institute in 1949 with the degree of B.S. in chemical engineering, and from the University of Texas in 1951 with the degree of M.A. in chemistry. He is the son of **Ray L. Dudley,** publisher of WORLD OIL.

•

Bert I. Graves, vice president and director of Tide Water Associated Oil Company, was recently made a member of the new Board for Development at New York University.

Dr. Harold Gershinowitz recently was named president of Shell Development company, replacing **Dr. M. E. Spaght.** Dr. Gershinowitz formerly was vice president, exploration and production branch of Shell Oil Company. He received his Ph.D. from Harvard, and later did graduate research work at Princeton and Columbia. He has been associated with Shell since 1938.

Dr. Gershinowitz

•

Herchel C. Smith, president of American Oil Company, delivered a New Year's Day talk for the CBS "Years of Crisis" radio broadcast, January 1. American Oil sponsored the special round table appraisal of world problems which included discussions by news commentators from all over the world.

•

S. A. Berthiaume has been promoted to assistant to the general manager by The Texas Company's Producing department, and moved from Denver to Houston January 1. Berthiaume received a Ph. D. from Cornell University where he was a geological instructor. He joined Texaco in 1940 and worked at Corpus Christi and Houston. He became division geologist for South Texas in 1948, and then moved on to senior geologist on the general manager's staff, Houston, in 1950. Since December, 1950, he has been assistant division manager of the Rocky Mountain division.

•

E. P. Ward, assistant to the manager of Production at The Ohio Oil Company's Findlay plant, has been appointed chief petroleum engineer. A graduate of the University of Oklahoma in geology, Ward worked at core drilling and surface geologic mapping before joining The Ohio as a roustabout in 1934. He advanced to assistant petroleum engineer at Iraan, Texas, in 1935 and was named West Texas district petroleum engineer in 1937. In 1941 he became Houston division petroleum engineer, serving in that capacity until his transfer to Findlay in 1951.

•

I. G. Burrell, division superintendent at Terre Haute, Ind., for The Ohio Oil Company, became assistant to the manager of Production at Findlay on January 1. He is a Colorado School of Mines graduate in petroleum engineering and was employed by The Ohio since 1931. His experience since then includes core drilling, title and tax work, roustabout, engineering, and foreman. He has been division superintendent of the Terre Haute division since 1948.

•

C. M. Hartwell, just returned from service in the armed forces, was named district superintendent for the Cities Service Oil Company (Del.) oil production division at Hobbs, N. M. He succeeds **R. W. Ely,** who is now assistant division superintendent with headquarters at Hobbs.

Dr. M. E. Spaght has been appointed executive vice president of Shell Oil Company. The executive vice presidency is a newly created capacity. As president of Shell Development company since 1949, Dr. Spaght has been in charge of the company's research in the U. S. He received his degrees from Stanford University and subsequently joined Shell in 1933 as a chemist.

Dr. M. E. Spaght

•

Joseph P. Walsh, general counsel of Sinclair Oil Corporation, has been elected chairman of the API Industries Committee, succeeding **Cyrus S. Gentry,** vice president and general counsel of Shell Oil Company. **Robert H. Scholl,** general counsel of Esso Standard Oil Company, was named secretary of the Committee to replace Walsh in that capacity.

•

Seymour W. Goerss is new superintendent of production for three affiliated companies, Dominion Natural Gas Company, Limited, Republic Light, Heat and Power Company, Inc., and Penn-York Natural Gas Corporation. Goerss returned to Dominion as geologist in 1945 after service with the armed forces. He will continue to direct geological development work.

•

C. J. Christensen has been named district superintendent of the Stanolind Oil and Gas Company's Lubbock, Texas, district. Formerly superintendent in Shreveport, Christensen replaces **M. M. Montgomery,** resigned. Christensen joined Stanolind in 1934 following graduation from the University of Nebraska in mechanical engineering. He was employed in the Rocky Mountain Division until 1937 when he was transferred to Oklahoma. Subsequently he has been employed in Colorado as field engineer, and in Fort Worth as assistant division engineer.

•

J. B. Jenkins was recently named superintendent of Stanolind Oil and Gas Company's Abilene District, an advancement from district engineer. An employe of Stanolind since 1935, Jenkins served in various engineering capacities in Texas and New Mexico until 1941 when he served with the Army. He rejoined Stanolind in 1946 as petroleum engineer in Fort Worth, and later worked at Lubbock and Pampa, Texas, offices. He was made district engineer at Abilene in 1950.

•

N. E. Trumbull, district petroleum engineer at Bakersfield, Calif., became division superintendent at Terre Haute for The Ohio Oil Company, January 1. Trumbull is a petroleum enginering graduate of the Colorado School of Mines and worked in mining fields in Wyoming and Arizona prior to joining The Ohio in 1936 as a roustabout at McFadden, Wyo. In 1945 he became petroleum engineer at Bay City, Texas, and then was transferred to Bakersfield in 1947.

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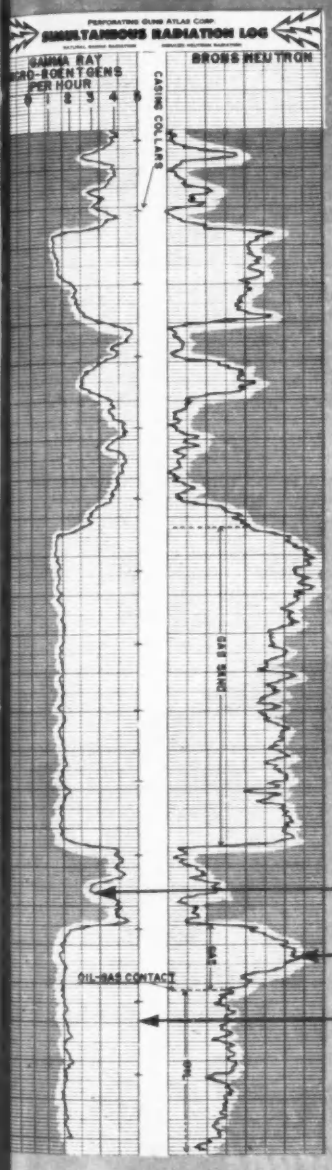

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George Sowards, chief petroleum engineer for The Ohio Oil Company in its Findlay offices, was named Los Angeles division manager, January 1. Sowards joined The Ohio as an engineer in 1923 and subsequently was engaged in various field operation in the Rocky mountain area. In 1938 he was made petroleum engineer in Casper, becoming division engineer three years later, and chief petroleum engineer in 1946. He is a member of the California Natural Gasoline Association, the AIME, API and other allied organizations.

George Sowards

•

E. E. Merkt Jr., has been appointed assistant to the vice president, Fort Worth division, of Gulf Oil Corporation. **H. P. Reardon** was named reservoir adviser and **O. K. Gilbreath, Jr.**, was made reserves co-ordinator.

•

C. H. Jameson, Jr. has been appointed a special partner of Manhart, Millison & Beebe, Tulsa petroleum exploration consultants. **J. J. Rupnik, T. E. Matson** and **A. L. Ballou, Jr.**, are also new partners in the firm.

•

F. H. Rhees, general superintendent of production for Sinclair Oil & Gas Company, was elected a vice president. He has been with Sinclair since 1925.

Myrven L. Mead has been promoted from assistant to the president to vice president of Northern Natural Gas Company. Mead has been with Northern since 1931 and has held distribution, engineering and sales positions. He was promoted from rate engineer to assistant to the president in 1950, He was graduated from the Engineering School of the University of Nebraska in 1931.

•

Leonard W. Groce was recently appointed assistant treasurer of Humble Oil & Refining Company. Groce joined Humble in 1934 and worked in the Treasury department section handling employe stock purchases, and later, Humble Annuity and Thrift Plan. He has been in the banking section since 1945 as assistant cashier.

•

W. D. Yale has been named assistant Gas division manager of The Texas Company's Producing department. He replaces **M. J. Adams** who was appointed division manager of Texaco's LPG Purchases and Sales division. Yale is a chemical engineering graduate of California Institute of Technology and has been with Texaco since 1938. Since 1945 he has been chief engineer of Gasoline and Cycling plants.

•

R. H. Park, gas engineer of the Gasoline and Cycling Plants, Gas division, The Texas Company, has been named chief engineer of that section. He is a chemical engineering graduate of Massachusetts Institute of Technology and joined Texaco as chemist-laboratory at Port Arthur, Texas, in 1939. He has been a gas engineer since 1951.

Morris A. Schellhardt, formerly chief petroleum engineer with El Paso Natural Gas Company, has joined the Gas Supply department of Transcontinental Gas Pipe Line Corporation, Houston, heading the Production Engineering department. Schellhardt has made many contributions to the study of gas well deliverabilities and production performance problems. He was with the U. S. Bureau of Mines and U. S. Geological Survey for 18 years.

Morris Schellhardt

•

Adolf Smith and **Maynard Smith** have opened oil offices in Houston. They now operate under the firm name of Smith & Smith.

•

J. A. Falkenberg has been advanced from district landman for The Texas Company in the Los Angeles Basin, to assistant division land and leaseman. He joined Texaco in 1931 as hall boy and advanced through office jobs to scout and then leaseman.

•

L. R. Shuey was promoted from leaseman to district landman in the Los Angeles Basin area by The Texas Company. Shuey joined Texaco in 1929 as file clerk and advanced through office positions to leaseman in 1944.

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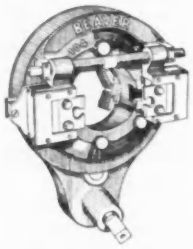
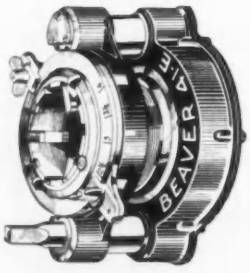
Beaver No. 104 Geared Square-end Knife Cutter cuts off square and clean without burr. Knives feed automatically — with safety guide ahead of cutting edge to prevent knife breakage. The No. 104 is ideal for cutting, grooving or beveling pipe. Furnished complete with operating ratchet.

Beaver No. 41-E Geared Threader is fully adjustable for undersize and oversize threads of uniform length. Threads all sizes, 2½" to 4", with one set of dies! Fully-enclosed gear case! Furnished complete with operating ratchet.



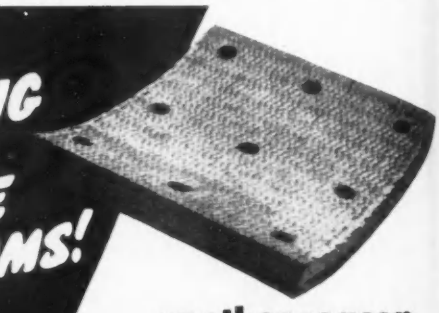
No. 104



No. 41-E

BEAVER PIPE TOOLS, INC.
254-300 DANA AVENUE
WARREN, OHIO · U. S. A.
"50 Years of Friendly Service"

NO SCORING OF BRAKE DRUMS!



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Standco NO-SMOKE BRAKE LINING

Standco Brake Blocks are made of cabled cords of long fibre asbestos — woven solid and reinforced with bronze wire to prevent pulling loose on the bolts. They will not burn or smoke or score brake rims.

More deep wells have been drilled with Standco than with all other blocks combined. It's your answer for low-cost hole-making.

STANDCO BRAKE LINING COMPANY
Factory and General Offices
2701-2801 Clinton Drive — Houston, Texas

CONDENSED

Statement of Condition

AT THE CLOSE OF BUSINESS DECEMBER 31, 1952

RESOURCES

CASH	$ 92,424,929.21	
UNITED STATES SECURITIES	49,790,035.41	$142,214,964.62
Municipal Bonds and Other Securities		6,012,295.84
Loans and Discounts	103,618,480.72	
Commodity Loans	16,268,029.00	119,886,509.72
Second National Bank Building		1,500,000.00
Future Banking Home Site		1,635,403.79
Other Real Estate		1.00
Vaults, Furniture and Fixtures		1.00
Interest Accrued on Investments		631,860.77
Customers Liability Under Letters of Credit		7,746,357.12
Customers Liability Under Acceptances		3,591,343.70
Other Resources		51,344.82
		$283,270,082.38

LIABILITIES

Capital	$7,500,000.00	
Surplus	7,500,000.00	
Undivided Profits	2,959,061.05	$ 17,959,061.05
Reserved for Dividends		300,000.00
Reserved for Taxes, Interest and Other Purposes		3,006,984.82
Letters of Credit		7,746,357.12
Acceptances		3,753,166.49
DEPOSITS:		
Individual, Firm and Corporation	$182,244,938.24	
Bank (Net)	62,382,157.63	
United States	5,877,417.03	250,504,512.90
		$283,270,082.38

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46 Years of Service to the Southwest

The SECOND NATIONAL BANK OF HOUSTON

MAIN AT RUSK

CAPITAL AND SURPLUS 15 MILLION DOLLARS

Member Federal Deposit Insurance Corporation

R. J. S. Pigott, director of engineering for Gulf Research & Development Company, retired last month but will continue as a consultant to the company. Pigott holds more than 30 patents on devices used in hydraulic engineering, heating, oil production, and instruments. He is retiring president of the ASME and has been active on many ASME committees.

•

H. H. (Bob) Roberts has been appointed assistant manager of the Public Relations Department of Standard Oil Company of California. His office is in Los Angeles. A standard-California public relations representative since 1925, Roberts joined the company in 1916 after graduating from the University of California at Berkeley.

Ralph C. Graham was designated executive vice president of Tennessee Production Company recently. He is a graduate in petroleum engineering of Missouri School of Mines and joined Tennessee Gas in 1945 as chief geologist. Graham is also a vice president of the present Tennessee Gas Transmission Company.

•

Joseph B. Bush was recently named supervisor of gas appraisals for Keplinger and Wanenmacher, petroleum engineers of Tulsa. With the firm four years, Bush has had 20 years experience in appraising oil and gas properties. A graduate of Stanford University, he began his career with Shell Oil Company, and was with British American Oil Producing Company prior to joining his present firm.

William F. Kenney has been appointed vice president and general counsel of Shell Oil Company, replacing **Cyrus S. Gentry**, retired January 1. Kenney, a law graduate of the University of Michigan joined Shell in 1937 as an attorney in St. Louis. Subsequently he advanced through more responsible positions to senior attorney in Houston, and to the New York office in 1945. Gentry has been a Shell vice president since 1944, but his affiliation with the company dates back to 1933.

William F. Kenney

•

J. H. Shonk, special assistant to The Ohio Oil Company's Terre Haute superintendent, became assistant division superintendent on January 1. He joined The Ohio in 1922 as a roustabout at Haynesville, La., advanced to farm foreman and in 1943 was transferred to Michigan in the same capacity. Subsequently he was named district foreman in 1944, superintendent in 1946, and assistant district superintendent in 1950.

•

Robert L. Bradley has been appointed supervisor of oil appraisals for Keplinger and Wanenmacher, petroleum engineers of Tulsa. Bradley has 19 years appraising experience, and has been with the firm seven years. He began his career with the Gulf Oil Company and has also worked with the Wilcox Oil and Gas Company, Grimes Gasoline Company, and Kingwood Oil Company.

•

William G. Lackey has been appointed assistant manager of the Exploration department of Stanolind Oil and Gas Company, Tulsa. Lackey, a graduate of Princeton University, has been with Stanolind since 1935 when he joined the company as a landman. In 1938, he became district landman at Wichita, Kansas, later serving as division landman in both Fort Worth and Houston. He was promoted to assistant leasing supervisor in Tulsa in 1945, and since 1948 has served as manager of the Land department. Lackey is a member of the Tulsa Landmen's Association and the New Mexico Oil and Gas Association.

•

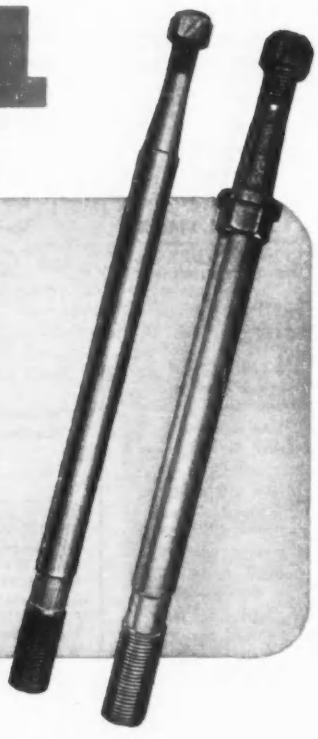
W. V. (Red) Roberts recently became associated with Darrell W. Smith, rotary workover contractor and Shirley Miller Drilling Company, both of Midland, Texas. He was appointed contact representative for both firms. Roberts formerly was associated with Western Drilling Company and Republic Supply Company, and has worked in the Permian Basin area since 1949.

•

Howard G. Vesper was recently named vice president of Standard Oil Company of California. Vesper, president of California Research Corporation since 1946, joined the oil company in 1922 following graduation from California Institute of Technology with a degree in chemical engineering. Vesper is co-holder of several patents and a contributor to a number of processes and developments in petroleum plant operation.

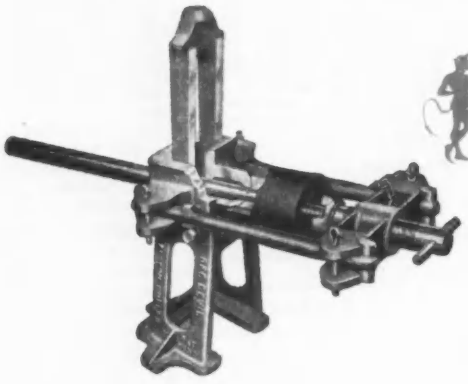
RED DEVIL

"DIA-HARD" PISTON RODS



For high pressure abrasive service

RED DEVIL Piston Rods are first choice where drilling conditions are severest because of the extreme hardness of the deep HIGH-CARBON wear resistant "DIA-HARD" case, coupled with tough core properties which give the highest tensile strength against breakage. All rods are hardness tested and precision gauged to maintain a world-wide reputation for quality. Write for Catalog No. P-101.



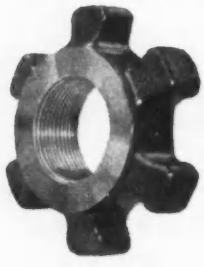
RED DEVIL **PISTON PULLER**

For tapered type rods

The usual practice of removing pistons from rods by blows of a sledge hammer often damages either pistons or rods. A Red Devil piston puller easily and quickly removes badly stuck pistons without injury to either part. All elements are made of finest quality alloy steel, heat-treated for strength and long life. Write for Catalog No. P-106.

RED DEVIL **PISTON ROD LOCK NUT**

These "Hammer Lug Type" nuts provide a fast and positive means for locking piston rod in crosshead. Made from alloy steel and heat treated, they will last indefinitely. Face of nut is precision machined for full seating surface at right angles to axis of threads to prevent fatigue stresses in rod. Write for Catalog P-102.



Complete information in Composite Catalog or write for price catalogs noted above. Red Devil products are available through your supply store.

OIL WELL MANUFACTURING CORP.

6008 S. Alameda Street, Los Angeles 1, California

DEATHS

Arthur Warren Ambrose, 63, chairman of the board, Cities Service Oil Company of Delaware, and a resident of Bartlesville, Okla., died December 28 in Tulsa. Ambrose was born at Lockeford, Calif., and entered the oil business in 1914 as a geologist for the Shell Oil Company. He went to Bartlesville in 1920 as superintendent of the Bureau of Mines and five years later joined Cities Service becoming president of the company in 1946. In January, 1952, he became chairman of the board. He also was a director of the Cities Service Oil Company (Ltd.) Toronto, Canada, and Cities Service Production Corporation. He was on the board of directors of Cities Service Company, Petroleum Advisers, Inc., Empire Gas and Fuel Company (Del.), Great Lakes Pipe Line Co., Richfield Oil Corporation and the Union National Bank of Bartlesville.

•

Robert William Clarke, 36, head of the Maintenance and Planning department of the Phillips Petroleum Company at Phillips, Texas, died Dec. 26, in Tulsa.

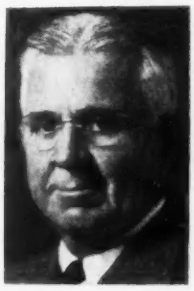
•

R. A. Welch, 81, died December 27 in Houston. Welch was chairman of the board of two large oil and sulfur royalty companies, Mound Company and Federal Royalty Company. He was a director of the Ashbel Smith Land Company and held extensive oil reserves.

•

Thomas J. Sinclair, Sr., 60, head of the production accounting department for Mid-Continent Petroleum Corporation, died December 17 in Tulsa. He had resided in Tulsa for the past 37 years.

Richard D. Montgomery, 62, vice president of Richfield Oil Corporation, died December 10 in Los Angeles. Montgomery entered the oil business upon graduating from college in mining engineering. He associated with independent companies until 1916 when he joined Standard Oil Company of California. He served as field engineer, resident engineer, engineer in charge of development in South America with operations in Brazil, Panama, Costa Rica, Colombia, Ecuador and Venezuela. He joined Richfield in 1926 and was elected a vice president in 1951.



R. D. Montgomery

•

J. R. Shayne, Sr., 76, pioneer Oklahoma oil man, died December 19 in Tulsa.

•

W. Grant Blanchard, 57, geologist with A. G. Oliphant, independent oil operator, died December 20 in Tulsa.

•

George W. Fox, Houston, died December 13. Fox was secretary and assistant treasurer of the Texas Pipe Line Company.

John W. Blue, 72, retired vice president of Standard Oil Company of Kansas, died January 2 in Houston. Blue was a native of Pleasanton, Kansas, but had resided in Houston for the past 20 years.

•

R. Y. Smith, 79, owner of the R. Y. Smith Oil Company, died December 22 at Electra, Texas. Born in Saltillo, Tenn., Smith was one of the earlier drillers in the Spindletop field, and later worked with T. P. Lee at Sour Lake. He was one of the founders of Smith & McDannald Company, formed in 1932 at Duncan, Okla.

•

Roger Q. Traweek, Sr., 62, died January 1 in Houston. Traweek was vice president in charge of coordination for Eastern States Petroleum Company, Inc., having the distinction of being the first man employed by Eastern States when it purchased the plant in 1935. In 1942 Eastern States built Traweek Terminal so named in recognition of his long service. While he was with the company it built up from an output of 2000 to 60,000 barrels of oil daily. He also served Deepwater Oil Company in 1928, and Gulf Oil Corporation in Port Arthur, Texas.

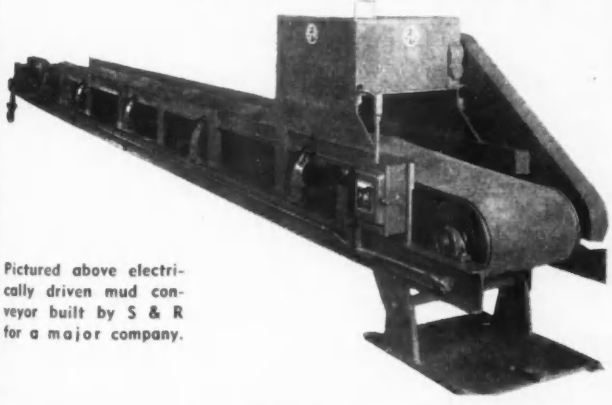
•

Jules Constantin, 55, formerly of Tulsa, died January 2 at Valmora, N. M., near Las Vegas. Constantin was an independent oil operator with headquarters in Dallas.

•

Claude L. Dobbins, Houston independent oil operator, died in Galveston December 21. Dobbins had operated independently since 1928, before which date he served as general manager of the Gulf Coast Oil Corporation and division manager of the Production department of Atlantic Oil Producing Company.

S & R SPECIAL *Custom Built*
MUD CONVEYORS FOR DRILLING BARGES



Pictured above electrically driven mud conveyor built by S & R for a major company.

Here's the answer to efficient movement of mud for your drilling barge—it's S & R's custom-built, electrically-powered, chain-drive mud conveyor.

Built for heavy duty service with quality materials equipped with reversible belt, troughing idlers, protected easily accessible drive housing. Operates efficiently all positions to 35° off horizontal. Built-in sizes to 40 feet.

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FOR SWABBING

AUTO-RELEASE WIRE LINE STRIPPER

Finest in the field. King Strippers represent outstanding advances in design and construction that assure long life and maximum operating efficiency:

- POSITIVE LATCH will not release by accident or surge of pressure.
- SURE RELEASE MECHANISM operated by rope socket striking bottom of the stripper.
- NON-SPARKING MATERIALS minimize fire hazard.
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- SIDE OPENINGS for inserting packing while line is in the hole.
- PACKING IS SELF-CENTERING; compression screws need not be evenly adjusted.

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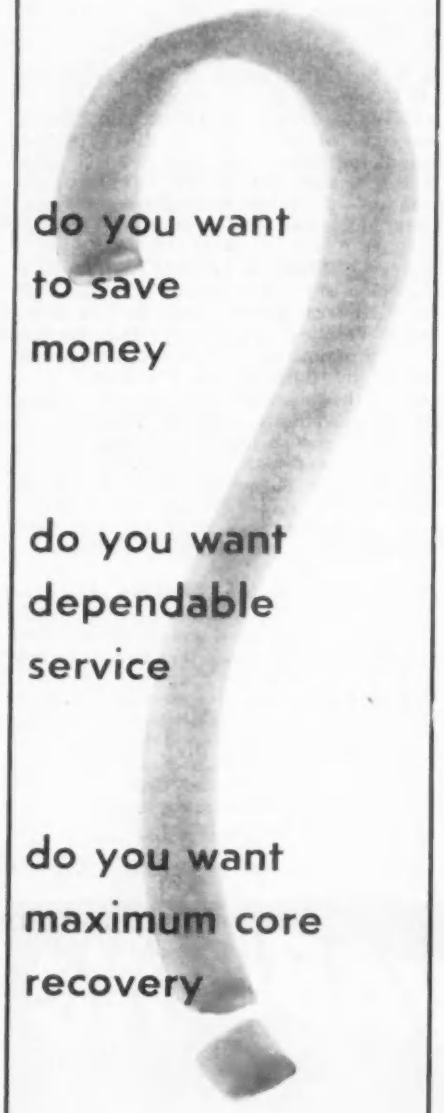

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Companies in the News——

SOCONY-VACUUM OIL COMPANY, INC., recently increased its board of directors from 11 to 12 upon the retirement of **Wilbur F. Burt.** New directors are **Fred W. Bartlett** and **George S. Dunham.** Bartlett is general manager of the Producing department and Dunham is vice chairman of the Manufacturing committee.

In addition, **Charles L. Harding,** a director since 1948, was elected vice president and a member of the executive committee. **Clark S. Teitsworth,** a director since 1947, succeeded Burt as director of coordination and Dunham succeeded Teitsworth as chairman of the Manufacturing committee.

Bartlett joined Socony-Vacuum in 1939 after 17 years experience in the U. S. and Mexico. He was appointed chief geologist of the Venezuelan company in 1940, holding that position until moving to headquarters in New York in 1943. He has been general manager of the Producing department for the past three years.

•

SINCLAIR OIL & GAS COMPANY, Production department, has made the following promotions and transfers:

O. G. Simpson, assistant district superintendent, located at Delaware, Okla., was promoted to district superintendent; **J. B. Rowland,** district superintendent, located at Pampa, Texas, was transferred to Drumright, Okla.; **W. B. Rhees,** district superintendent, located at Hobbs, N. M., was transferred to Chase, Kansas; **C. C. Salter,** district superintendent, located at Wink, Texas, was transferred to Hobbs, N. M.; **H. A. Randolph,** district superintendent, located at Covington, Okla., was transferred to Wink, Texas; **E. H. Gibbons,** district superintendent, located at Chase, Kansas, was transferred to Covington, Okla.; **John P. Hammett,** assistant district foreman, located at Big Spring, Texas, was transferred to Sonora, Texas; **Robert J. Brasel,** junior petroleum engineer, located at Delaware, Okla., was transferred to Drumright, Okla.

•

GENERAL PETROLEUM CORPORATION has announced five executive changes: **John C. Sampie,** director, was appointed a vice president-manufacturing, pipe line and supply. **R. O. Swayze** was elected vice president and director-production; **J. T. Durkee** was elected treasurer and director. **A. D. Bennison,** manager of Oil Exchange and Supply, was elected director-Oil Supply. **A. O. Woll,** Marine Department, **M. S. App,** Production, and **Wesley Cunningham,** treasurer, are retiring directors. They have been with the company or affiliates 42, 40 and 34 years respectively.

•

MAGNOLIA PETROLEUM COMPANY'S Natural Gas department has promoted the following: **G. S. Gray,** assistant superintendent of Pegasus district in West Texas, to Smackover, Ark., as assistant superintendent of the Shreveport-Rodessa area of the Rusk district; **J. R. Leonard,** assistant mechanical engineer of construction and maintenance section, to assistant superintendent of the Pegasus district with headquarters at Midland, Texas.

MAGNOLIA PETROLEUM COMPANY'S Petroleum Engineering department listed the following promotions recently. **L. W. Randerson,** Midland, Texas, senior engineer; **B. A. Barnes,** Dallas, section chief in charge of fluid injection and hydrology.

Charles F. Girand and **Gerald L. Smith,** Dallas, to senior engineers; **Gilbert M. Andreen,** Dallas, district engineer for the Producing district at Alice, Texas; **John D. Howard,** Vanderbilt, Texas, district engineer at Vanderbilt, succeeding **W. A. Daniel;** transferred to Kermit, Texas, as district engineer.

J. W. Whitney, Jr., Shreveport Producing district, to Wewoka, Okla., as district engineer; **A. J. Monzingo,** district engineer at Wewoka, to Salem, Ill., as district engineer; **Jack H. Ray,** Brownfield, Texas, district, to district engineer of the Rodessa, La., district.

Ollie J. Ford, district engineer at Kermit, to Dallas proration section; **Robert E. Ritchie,** engineer in Kermit district, to Shreveport; **John P. Lowe, Jr.,** engineer at Falfurrias, Texas, to Alice, Texas; **John N. Schuelke,** engineer in Brownfield district, to Falfurrias district.

Norman Bellinger, engineer in the Cushing, Okla., Producing district, to Vanderbilt; **James D. Harrington,** engineer at Kermit, to Midland, Texas. **Oscar C. Person,** engineer at Alice, was moved to Midland.

Charles W. Hickok, engineer at Electra, Texas, to Brownfield. **J. A. Petty,** engineer in Rusk Producing district at Kilgore, to Cushing Producing district with headquarters at Drumright, Okla.

•

MAGNOLIA PETROLEUM COMPANY recently made five changes in its Geological department. **Joseph Neely,** Midland district geologist, and **W. L. Moreman,** Oklahoma district geologist in Oklahoma City, were made staff geologists in Dallas. **F. E. Wimbish,** Wichita, Kansas, district geologist, was transferred to Midland, Texas, as district geologist for West Texas. **J. E. Bucher** was named to Oklahoma City as district geologist for Oklahoma. **Owen H. Blexrud** was advanced to geologist for the Kansas district at Wichita.

•

MAGNOLIA PETROLEUM COMPANY named two Geophysical department men in recent promotions. **George W. Isensee** was named seismic supervisor and transferred to headquarters in Dallas. **O. H. Armstrong** was advanced to seismic supervisor at Bismarck, N. D.

•

GREAT LAKES OIL & CHEMICAL COMPANY began operations in California under its own name in January. Company headquarters will be moved from Grand Rapids, Mich., to Los Angeles early this year and all properties of the Cleveland Oil Company will be absorbed by Great Lakes operation. The company recently spudded its first California well, Edison No. 2 in West Edison field near Bakersfield, under its own name. Petric Drilling Company was given contract for the well.

Association News

Technical Sessions Featured By AIME Petroleum Branch

Petroleum Branch activities scheduled for the 1953 annual meeting of the American Institute of Mining and Metallurgical Engineers convention being held at the Hotel Statler, February 14-19, in Los Angeles, will feature three technical sessions and a symposium.

F. L. Wadsworth and M. E. Loy, associate chairmen, will conduct the morning technical session Tuesday, February 17. Two Magnolia Petroleum Company representatives, T. W. Watkins and M. D. Nelson, will present "High-Temperature Gelation of Drilling Fluids." M. King Hubbert, Shell Oil Company, will detail "Entrapment of Petroleum Under Hydrodynamic Conditions."

The Tuesday afternoon session highlights a symposium on valuation of oil and gas properties conducted by Kenneth E. Hill and Everett G. Trostel, associate chairmen. Paul Paine, consultant in Los Angeles, will give the introductory remarks, followed by: "Valuation of Oil Properties," by Dean Sheldon, Los Angeles consultant; "Valuation of Natural Gas Properties," by Ralph E. Davis, consultant, Houston; "Valuation of Oil and Gas Properties for Loan Purposes," by Lyon F. Terry, Chase National Bank; "Valuation in Petroleum Security Analysis," by Edwin L. Kennedy, Lehman Brothers. A discussion will follow.

Morning and afternoon technical sessions are scheduled for Wednesday, February 18. C. R. Dodson and Kemp E. Barley will conduct the morning session: "Use of Automatic Free Piston in Oil Well Production Problems," by E. D. McMurry, Garrett Oil Tools, Inc.; "Capillary Desaturation in Porous Glass Bead Systems," by John C. Calhoun and Frank T. Bethel, Pennsylvania State College; "Well Spacing and Reservoir Performance — Spraberry Trend Area," by Lincoln F. Elkins, Sohio Petroleum Company.

J. Shannon Baker and A. H. Bell will moderate the afternoon session on Wednesday: "Recent Laboratory Investigations of Water Flooding in California," by Norris Johnston and N. van Wingen, Petroleum Technologists, Inc.; "The Effect of Viscosity Ratio on Relative Permeability," by A. S. Odeh and S. T. Yuster, University of California at Los Angeles; "Steady-State Flow of Gas Through Capillary Tubes," by George C. Wallick, Magnolia Petroleum Company.

The Petroleum Branch dinner will be held at 7:00 p.m. on Tuesday, and the Wednesday sessions will be followed at 7:00 p.m. by the AIME annual banquet and president's reception.

The Petroleum Branch executive committee meeting will be held Monday, February 16, at 9:00 a.m. The AIME Welcoming Luncheon is scheduled Monday at 12:15 p.m. with Governor Dan Thornton, Colorado, the main speaker. R. B. Gilmore will preside over the afternoon session, "World Oil and Gas Developments in 1952." The annual review will be presented by members of the 1952 production review committee: E. W. Berlin, chairman; R. B. Gilmore, domestic vice-chairman; Alexander H. Chapman, foreign vice-chairman; and committee members Alfred H. Bell, Raymond M. Larsen, Lawrence W. Chasteen, Milton Williams.

The AIME Stag Smoker will be held Monday at 7:30 p.m.

NEWLY ELECTED OFFICERS of the Permian Basin Geophysical Society are pictured above. Left to right: E. L. Campbell, National Geophysical Company, treasurer; L. Decker Dawson, Dawson Geophysical Company, first vice president; George A. Grimm, Tide Water Associated Oil Company, president; and Joseph S. Pluta, Standard Oil Company of Texas, secretary. William A. Reeves, Midland Geophysical Company, second vice president is not shown, nor is R. M. Nugent, Magnolia Petroleum Company, district representative to the Society of Exploration Geophysicists.

NACE Conference to Meet In Chicago March 18-20

Delegates to the National Association of Corrosion Engineers conference, scheduled to be held in Chicago March 18-20, will have opportunity to attend several symposiums.

The Oil and Gas Industry Symposium will be held March 18 from 2 to 4:15 p.m. and will consist of three papers on casing corrosion, inhibitor evaluation methods and sweet oil well corrosion. Jack L. Battle, Humble Oil & Refining Company, Houston, will summarize present understanding of casing corrosion problems. E. C. Greco, United Gas Pipe Line Company, Shreveport, and J. C. Spaulding, Jr., Sun Oil Company in Dallas, will discuss methods of manufacturing inhibitors. Corrosion in sweet oil wells will be presented by H. E. Greenwell, Atlantic Refining Company, Dallas.

Five papers will be given at the Protective Coatings Symposium on March 20 from 9 to 11:30 a.m. "Coating Research and Applications in Atomic Energy Operations" will be given by C. D. Watson. Other subjects and their authors are, "Field Tests of Exterior Coatings for a Pipe Line Conveying Fuel Oil Heated to 200° F.," E. R. Stauffacher and B. R. Davidson; "Filiform Corrosion" by Maurice VanLoo; "Effects of the Composition of Steel on the Performance of Organic Coatings in Atmospheric Exposure," F. L. LaQue and J. A. Boylan; "Weld Seams and Weld Flux Effects on Coating Life," A. J. Liebman.

A Pipe Line Coatings Session will be presided over by E. R. Lopez, session chairman, of Barrett Division of Allied Chemical & Dye Corporation. Ten speakers representing all phases of the industry will present their viewpoints, problems and progress.

Protection of underground cable installations is the theme of the Electrical and Communications Symposium scheduled March 18 from 2 to 4:15 p.m. Two sessions are scheduled by the Chemical Industry Symposium; March 19 the meeting will be held from 2 to 4:15 p.m.; March 20 from 9 to 11:30 a.m.

Papers will deal with the metallurgist's viewpoint towards corrosion; corrosion data for various alloys exposed to a number of acids; use of all-plastic piping and equipment; corrosion resistance of titanium; graphical method of multiple correlation analysis of experiments having several variables; atmospheric weathering tests of aluminum alloys; corrosion study in a salt plant, and recent developments in corrosion inhibition.

Canadian Members Petition NACE For Hamilton Division

Canadian members of the National Association of Corrosion Engineers have asked that the association establish a regional subdivision in Canada. The first local subdivision will probably be centered at Hamilton, Ontario.

Two petitions for new U. S. sections of NACE originated at San Diego and Jacksonville, Fla. The San Diego and Jacksonville sections will be the 26th and 27th when organized. NACE now has 4000 members throughout the world.

Chemical Industry Symposium Sponsors Seven Discussions

Seven papers scheduled to be delivered at the National Association of Corrosion Engineers' Conference at Chicago March 18-20, 1953, have been announced by C. A. Coberly, Mallinckrodt Chemical Works, St. Louis, Chemical Industry symposium chairman. The Chemical Industry Symposium is one of eleven scheduled for the meeting, which will be held at Hotel Sherman.

The titles and names of the papers' authors are:

"Use of All-Plastic Equipment and piping in Technical Corrosion Protection," by J. L. Huscher, American Agile Corporation;

"Corrosion by Acids at High Temperatures," by R. F. Miller, R. S. Treseder and A. Wachter, Shell Development Company;

"Metallurgy of Corrosion," by F. Prange, Phillips Petroleum Company;

"Statistical Analysis of Corrosion Data," by O. D. Ellis, Armco Steel Corporation;

"Corrosion Study in a Salt Plant," by H. B. Rickert, Michigan Chemical Company and H. O. Teeple, International Nickel Company;

"The Behavior of Titanium in Sulfuric and Hydrochloric Acids," by G. C. Keifer, Allegheny Ludlum Steel Corporation.

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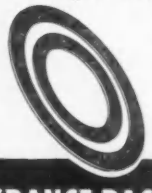

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NEW YORK NOMADS ELECTED Russ V. McIntire, Baker Oil Tools, Inc., as chapter president for 1953 to succeed A. A. Dill, Axelson Manufacturing Company. Shown (left to right) above are retiring president Dill, and new 1953 officers: G. I. Lynch, Lee C. Moore Corporation, assistant secretary; Edmund Burke, Jr., General Motors Overseas Corporation, sergeant-at-arms; C. J. DeLay, The Continental Supply Company, Inc., vice president; McIntire; C. B. Latrobe, Hughes Tool Company, secretary; N. L. Boulden, Jr., International General Electric Company, Inc., treasurer; and L. F. Griffith, Petroleum Machinery Corporation, assistant treasurer.

Western Oil and Gas Society Elects Aubert President

L. L. Aubert, president of Bankline Oil Company, has been elected president of the Western Oil and Gas Association for 1953, succeeding R. L. Minckler, president of General Petroleum Corporation. Other officers include:

Charles S. Jones, president of Richfield Oil Corporation, first vice president; John W. Hancock, executive vice president of Hancock Oil Company, second vice president; and William Reinhardt, vice president of Union Pacific Railroad Company, treasurer. John M. Peirce was reelected a vice president and general manager.

Newly elected to the board of directors were F. W. Borden, California district manager for Sunray Oil Corporation; E. J. Hamner, area manager for Humble Oil & Refining Company; and T. H. Wallace, vice president of Western Gulf Oil Company. Twenty-nine incumbent members were reelected.

North Texas Landmen Elect 1953 Association Officers

The North Texas Landmen's Association has elected J. H. Ball, landman for Phillips Petroleum Company, 1953 president of the Association. Ball succeeds J. G. Rowe, Humble Oil & Refining Company. Rowe was named chairman of the executive committee.

Marvin S. Jones, Magnolia Petroleum Company, was elected vice president and James S. Maxwell, Jr., Continental Oil Company, was elected secretary-treasurer.

Oil Compact Meeting in April

The Interstate Oil Compact Commission will hold its Spring meeting in New Orleans, April 24-25, with headquarters in the Roosevelt Hotel. Hotel reservations for the event should be sent to IOCC Headquarters Office, Box 3127, Oklahoma City. The commission has reserved a block of rooms, reservations for which must be verified by April 8.

Houston API Chapter Elects Leonard Swanson '53 Chairman

Leonard Swanson, Standard Oil Company of Texas, was elected 1953 chairman of the Houston Chapter, API, succeeding Charlie Laas, Gulf Oil Corporation. Swanson stepped up from his 1952 post of first vice chairman.

Herb Treichler, Houston Oil Company, last year's program chairman, was made first vice chairman. John Payne, Shell Oil Company, was elected second vice chairman, succeeding Bill Bartle of Brewster-Bartle Drilling Company, and Leo McConnell, Lane-Wells Company took over the job of secretary-treasurer from Stan Wickstrom, David Bintliff Company.

Advisory Committee for the coming year consists of the retiring chairman, Laas, Roy Bobo, Phillips Petroleum Company, J. D. McBrayer, Ohio Oil Company, John Suman, Jr., Humble Oil & Refining Company, B. O. Ellington, Baker Oil Tools, Inc., Millard Clegg, Meredith, Clegg & Hunt, and Bartle.

Creelman Elected Chairman Of ACS Gas-Fuel Chemistry

The Gas and Fuel Chemistry division of the American Chemical Society has elected George D. Creelman chairman for 1953. Creelman, director of research of M. A. Hanna Company in Cleveland, succeeds Dr. John F. Foster, supervisor of fuels research at Battelle Memorial Institute, Columbus, Ohio.

Dr. Corliss R. Kinney, professor of fuel technology at Pennsylvania State College, was named chairman-elect, with Dr. Harlan W. Nelson, Battelle, reelected secretary-treasurer.

Kansas Independents Elect

Kansas Independent Oil & Gas Association recently elected George Bruce, Wichita, president of the Association. He succeeds R. J. Harwood, Wichita. Tom Orr was reelected executive secretary. R. E. Mallonee and W. R. Murfin, both of Wichita, were elected secretary and treasurer, respectively.

Dallas Geologists Elect Hamm as 1953 President

Dallas Geological Society recently announced results of its 1953 election of officers. W. Dow Hamm, general manager of exploration for Atlantic Refining Company, was named president.

Other executive officers included Henry Rogatz, consultant, vice president; G. Frederick Shepherd, chief geologist of General American Oil Company of Texas, secretary-treasurer; Paul E. Nash, director of geophysical exploration for Magnolia Petroleum Company, executive committeeman. Wallace Ralston, Geological department of Sun Oil Company, is past president.

Canadian Drilling Contractors Recommend Safety Regulation

Directors of the Canadian Association of Oilwell Drilling Contractors, at a recent meeting in Calgary, unanimously agreed to recommend to the Workmen's Compensation Board that the following paragraph be incorporated into the new safety regulations:

"Unless a rig is adequately lighted by natural light, no drill pipe shall be disconnected during a drill stem test unless there is no possibility of any oil or gas being present in the drill pipe."

The use of flood lights was not believed to be feasible and a discussion of the entire industry was held at the December quarterly meeting at Calgary.

Tennessee Oil Men Elect William Pettway President

William D. Pettway, Pettway Oil Company of Chattanooga, was elected president of the Tennessee Oil Men's Association at its annual meeting held recently in Memphis. Three vice presidents elected were John C. Howren, Holston Oil Company; H. L. Noblitt, Noblitt Oil Company; and Carl Nix, Nix Oil Company.

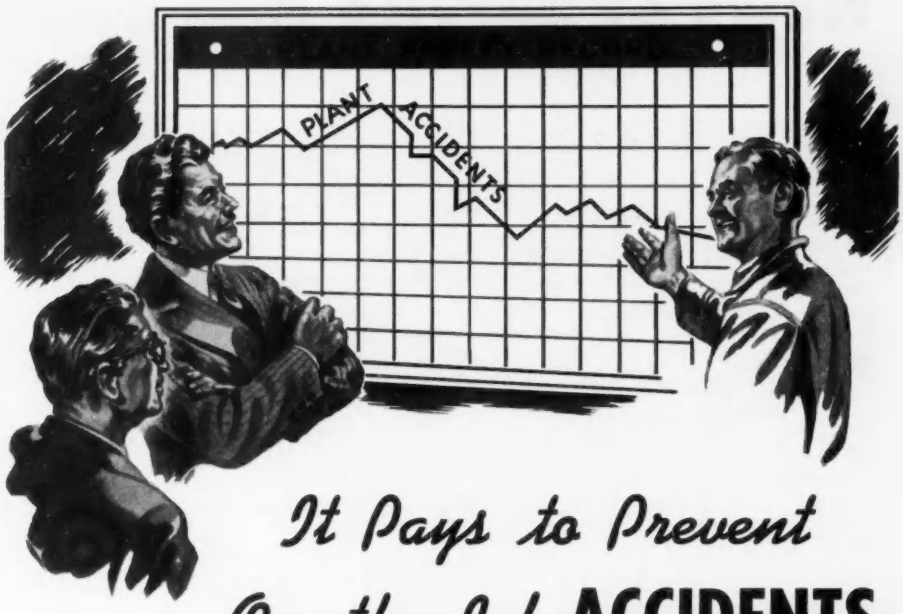
E. Pellettieri, Southern Oil Service was reelected secretary-treasurer and A. T. Levine, Nashville was named general counsel.

W. H. Carson Named Chairman 1953 Gas Measurement Course

The annual Short Course for gas measurement, sponsored by the College of Enginering, University of Oklahoma, Norman, will be held April 21-23. The 1953 school will be the 28th held.

W. H. Carson, University of Oklahoma, is chairman of the executive committee of the Southwestern Gas Measurement Short Course. Other executive committee members are E. C. McAninch, Oklahoma Natural Gas Company, Ardmore, Okla.; R. M. Scofield, Lone Star Gas Company, Dallas; C. E. Terrell, Southern Natural Gas Company, Birmingham; Ben F. Worley, United Gas Corporation, Shreveport; James L. Griffin, Northern Natural Gas Company, Omaha; and W. H. Woods, Union Sulphur & Oil Corporation, Houston.

T. S. Whitis, vice president of West Texas Gas Company, is general chairman of the Short Course. Garth McClintock, Colorado Interstate Gas Company, Colorado Springs, Colo., and George H. Schmitt, Jr., New Orleans Public Service, Inc., New Orleans, were named replacement members of the general committee.



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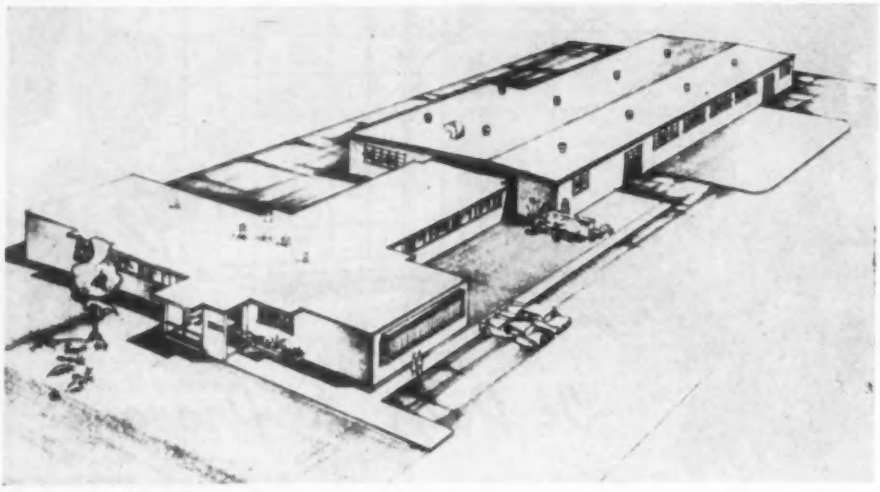


FORT WORTH FACILITIES are being erected for Welex Jet Services, Inc., by Thomas S. Byrne, Inc., of Fort Worth. Work began in December and should be completed in May, 1953. The company was incorporated in 1945 to offer a new jet process for oil well perforating. Welex added radioactivity well logging service a year ago, and this service will soon be available in all areas.

Colorado Fuel and Iron Names Leonard To Tubular Products

W. W. Leonard has been appointed assistant manager of Tubular Sales for The Colorado Fuel and Iron Corporation, in preparation for new marketing and servicing necessary when C. F. & I.'s new seamless pipe mill opens next fall. Leonard graduated from Texas College of Mines and Metallurgy and then joined Youngstown in 1936 as a metallurgist. His tubular products experience includes eight years field engineering and sales with Continental Supply Company.

Jones & Laughlin Incorporates Supply Company as a Division

Jones & Laughlin Supply Company, Tulsa, became a division of Jones & Laughlin Steel Corporation on January 1. Canadian assets of the Supply Company were sold to the Jones & Laughlin Steel Sales Company, Ltd., a Canadian subsidiary. Rainey Elliott, Tulsa, new vice president, and director of the Supply Company, was named general manager of the Supply Division.

Rainey Elliott

John L. Shakely, president of the Supply Company, retired after 39 years service but will remain with the Supply Division as consultant.

Other changes named George L. Sutter, director of sales for the Supply Company, as assistant general manager of the division; Robert J. Woods, Jr., director of sales; Paul R. Warner, assistant treasurer; Harold H. Wilson, Houston, director of Gulf Coast operations; H. Lee Wilkins, Calgary, Alta., formerly manager of Canadian operations for the Supply Company, as manager of the Jones & Laughlin Steel Sales Company, Ltd.

Walter O'Bannon Company Elects F. W. Budde Secretary-Treasurer

Walter O'Bannon Company, Tulsa, has appointed F. W. Budde secretary-treasurer of the company and has also named Kenneth N. Mills as chief engineer. Budde formerly was assistant to the vice president and treasurer of Tellepsen Construction Company. He also was associated with H. K. Porter Company, Jarecki International Supply Company and Hinderliter Tool Company.

Mills was machinery products manager for Dresser Equipment Company prior to his appointment. He was also associated with Emsco Derrick and Equipment Company as assistant chief engineer. Mills has published numerous articles on oil well production and drilling problems.

Lane-Wells Company Announces Opening of Three New Stations

Lane-Wells Company has opened three new stations at Glendive, Mont., Winters, Texas, and Virden, Manitoba.

Charles L. Naus, formerly employed at Williston, N. D., was named station superintendent of the new Glendive truck station. At Winters, W. D. Copper, previously stationed at Wichita Falls, Texas, is operator-in-charge. The new Canadian truck station at Virden is assigned to Joseph H. Donovan, operator-in-charge. He was with Canadian Gulf Oil Company prior to joining Lane-Wells.

Chicago Pneumatic Tool Elects Coffey President

Guy J. Coffey has been elected president of Chicago Pneumatic Tool Company, succeeding W. L. Lewis, deceased. He replaces H. A. Jackson, chairman of the board, who has been acting president since June, 1952. Coffey has been vice president in charge of sales and a director since 1945.

The board also elected Thomas P. Harris and James F. Huvane as vice presidents of the company.

Century Geophysical Corporation Appoints Two Seismic Explorers

Neal Clayton has been appointed assistant manager of the Domestic Field division of Century Geophysical Corporation, Tulsa. He is a graduate of Mississippi College in physics and holds an M.S. degree from Louisiana State University. Clayton's experience includes 16 years seismic exploration including two years in Venezuela and two years as associate physicist for Naval Ordnance Laboratory in Washington. He has worked in all the oil provinces of the United States and has specialized in surface and pattern shooting as applied to areas which are particularly difficult to work by seismic methods.

P. I. Bediz was promoted to chief geophysicist for the Domestic and Canadian operations. He graduated from Galatasaray Lyceum, Istanbul, Turkey, and also attended the University of Istanbul. Bediz has 11 years seismic experience and has worked in major oil provinces of U. S., Canada and Turkey.

Four Wheel Drive Company Promotes Joe DeCoursin to General Manager

G. F. (Joe) DeCoursin has been appointed general sales manager of The Four Wheel Drive Auto Company of Clintonville, Wis. DeCoursin joined FWD in 1936 as a member of the factory crew, and progressed to purchasing, production and application capacities. He became manager of the Standards department in 1945, and then took leave of absence to attend the University of Wisconsin and Iowa, studying business and sales management. In 1950 he was named field sales manager and has traveled extensively on behalf of the company.

Bethlehem Supply Appoints Spalding, Gulf Coast Manager

J. V. Spalding was appointed division sales manager of the newly created Gulf Coast division for Bethlehem Supply Company effective January 1. Spalding has been with Bethlehem Supply for 13 years, having started in the Tulsa office as sales engineer in 1939. He is a Missouri School of Mines graduate in petroleum engineering.

J. V. Spalding

W. J. Brady was named resident sales manager in charge of the Houston office. He formerly was district manager of the Southwest Texas district with headquarters at Corpus Christi. Guy Brown, Jr., is Division Machinery Sales representative in Houston. He has been working in Houston.

T. C. Graham replaces Brady at Corpus Christi. Graham, a Bethlehem veteran of more than 11 years, was transferred from Oklahoma City district.

Chemical Bank & Trust Opens New Oil and Gas Department

Chemical Bank & Trust Company, New York, has established an oil and gas department for all phases of the industry under the supervision of Howard W. McCall, Jr., vice president.

Philip F. Shannon was appointed senior consultant and Ben F. Zwick was named manager of the department. Shannon was a professor of petroleum engineering at Colorado School of Mines, and affiliated with several oil companies in the Americas prior to joining the bank. Zwick, a graduate of Colorado School of Mines, began his oil career in South America in 1929 and joined Standard Oil Company (N. J.) in 1947 to coordinate producing operations in Europe, the Middle East and the Far East. He became president of Husky Oil Company, Cody, Wyo., in 1948. He has been in consultation work since 1950.

Stracho Engineering Corporation Opens New Office in Shreveport

Stracho Engineering Corporation, recently established at Shreveport, La., will specialize in process piping and welding as well as machinery and product development. Principals of the organization are A. M. Croswell and Walter S. Rae, Jr.

Croswell, executive vice president of Stracho, has been welding and project engineer for Gulf Southern Contractors on the 1200-mile pipe line expansion program being built for United Gas Pipe Line Company. In 1944 he was chief spread inspector of construction on the Big Inch pipe line built for Tennessee Gas and Transmission Company.

Under his supervision the company will offer engineering services in connection with gas and oil transmission pipe lines and allied work.

Rae, a University of Wisconsin graduate, will supervise work in special machinery, tools and products, a responsibility he held with A. O. Smith Corporation. While with Falk Corporation, Milwaukee, he invented an oil seal with no wearing parts; at Allis-Chalmers Manufacturing Company he was co-designer of the original 4500 horsepower coal burning gas turbine propulsion unit; he also designed the astern and low pressure turbines used by the Navy during the war.

American Iron & Machine Names Canadian, Gulf Coast Salesmen

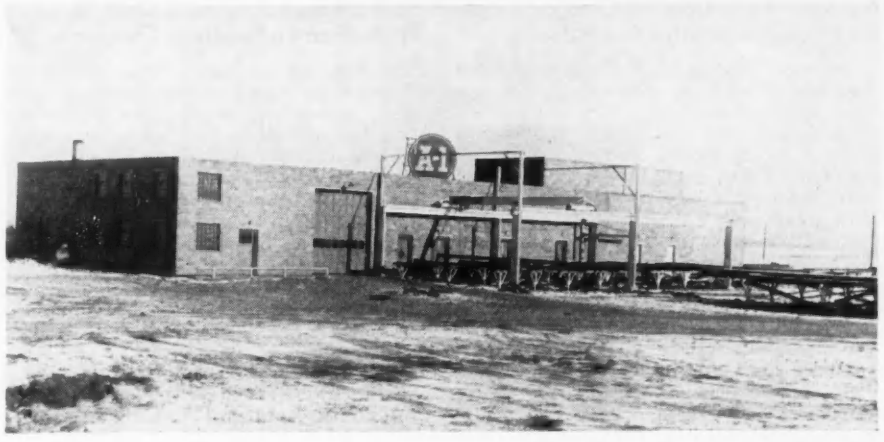
American Iron and Machine Works Company, Oklahoma City, has appointed Lee H. Christianson as representative in Canada. Christianson will establish headquarters in Calgary, Alberta. He previously was with Halliburton and with Hughes Tool Company in Canada.

In addition the company named Jack R. Gary to represent them in the Gulf Coast area. Gary will specialize in production equipment. His headquarters will be in Houston.

The company recently reelected its entire board of directors.

Allis-Chalmers Director Named

Allis-Chalmers Manufacturing Company has elected William E. Buchanan, president and treasurer of the Appleton Wire Works, Inc., to the board of directors. Buchanan fills the vacancy created recently when Edmund Fitzgerald, president of Northwestern Mutual Life Insurance Company, resigned.



REPAIR SERVICE AT TIOGA, N. D., will be provided by A-1 Bit & Tool Company in this new shop just recently opened. It is equipped with machine tools for repairing drawworks, threading of drill pipe and collars, installation of tool joints. Harry Dull, formerly with Tex-La Tool Company, Beaumont, is shop superintendent. Joe Castles is district manager of the Rocky Mountain division with headquarters at Tioga.

H. C. Smith Promotes Pair

Two new appointments have been made by H. C. Smith Oil Tool Company. E. K. Faulds, with the company since 1949, has been named vice president and treasurer. Arthur S. Marshall was named general sales manager in charge of domestic and foreign sales. He joined the company in 1936 and has served in various capacities including general service manager, welding plant foreman, and heat treating foreman.

Detroit Diesel Appointment

Detroit Diesel Engine Division of General Motors has appointed L. A. Holmes to the petroleum sales staff in Tulsa. Holmes, formerly an instructor at the factory service school, is a graduate of Oklahoma Institute of Technology. He succeeds C. J. Davy who was appointed sales representative for the GM Division in Alabama, Georgia and Florida.

McEvoy Area Office Moved

McEvoy Company, Houston, has transferred Henry M. Stanley, salesman, to Corpus Christi. Stanley has been with McEvoy since 1944, with headquarters at Alice, Texas. He will continue to cover Southwest Texas.

New Aluminum Plant Planned

Aluminum Company of America will build a new fabricating plant near Lancaster, Penn., for production of aluminum screw machine products. Cost of construction is estimated at $3 million. Monthly shipments are expected to be in excess of 500,000 pounds when the one story plant is completed.

Expansion of the company's Vancouver Fabricating Works was scheduled to get underway in January. Total cost is estimated at $1.7 million, with completion scheduled for late 1953.

New Plant Making Pipe

Michigan Plastic Pipe Company is a new Michigan manufacturer of Tufflite Rigid and Flexible Plastic Pipe. The board of directors is composed of John R. J. Grylls, George W. Welsh, J. V. Wicklund, E. G. Munz, and A. G. Ghysels. The plant is located at Melvindale.

Donnelly Joins U. S. Steel

Walter J. Donnelly, recently resigned as U. S. High Commissioner for Germany, became associated with U. S. Steel Corporation interests in Central America in January. He will make his home at Caracas, Venezuela.

SCHLUMBERGER MANAGEMENT MET in Houston recently for a special course in personnel management under supervision of A. M. Allegret, director of training. Attending the course were, left to right: Bill Hartsell, Laurel, Miss.; Jim West, Magnolia, Ark.; Barry McVicar, Regina, Canada; Tom Morris, Harvey, La.; Ray Houston, Houston; Lester Heath, Wichita Falls, Texas; Randy Elliott, Shawnee, Okla.; Ed Ramsay, Corpus Christi; Ike Eickmeyer, Abilene, Texas; Earl Labertew, Flora, Ill.; George Thomen, Beaumont, Texas; Al Phares, Sidney, Nebr.; George Hepburn, Long Beach, Calif., and A. M. Allegret, Houston.

National Tube Division Creates New Pipe Lines Sales Department

Arthur J. Elbert, Jr., has been appointed manager of sales-pipe lines, a newly created position in the general sales department of U. S. Steel's National Tube Division. Elbert has been with National Tube since 1937 when he started as a laborer at the company's Christy Park Works at McKeesport, Penn. He was made sales service engineer at Tulsa in 1946, and returned to Pittsburgh in 1949 as a pipe line engineer. He has also been special representative handling trunk pipe lines.

Arthur J. Elbert, Jr.

Kaiser Steel Corporation Names McMeans Operations Executive

George B. McMeans has been elected vice president-operations for Kaiser Steel Corporation with responsibility for the Kaiser Fontana, Calif., plant and mining operations at Eagle Mountain, Calif., and Sunnyside, Utah.

McMeans began his steelmaking experience at age 16, working in steel mills in the Pittsburgh area during summers while attending school. He is a metallurgical engineering graduate of Lehigh University.

Callan Heads New N. Y. Office Opened Recently by D. W. Onan

New York export offices have been opened by D. W. Onam & Sons, Inc., Minneapolis manufacturers of electric generating equipment. A. S. (Scotty) Callan, Allerton, N. Y., was named manager of the office. Callan is a graduate of Cooper Union and New York University and holds a B. S. in electrical engineering. He has been associated with International Standard Electric Company of New York for the past eight years.

A. S. Callan

Walters Heads Houston Office For Rockwell Manufacturing

Rockwell Manufacturing Company has named J. H. Walters as new Houston district sales manager. He will be responsible for the coordination of all Meter and Valve Division sales in the Houston district, covering Texas and Louisiana.

Walters joined Rockwell in 1945 as sales engineer, and recently served as Houston gas sales supervisor.

Honeywell Names Wishart

Paul B. Wishart, vice president of Minneapolis-Honeywell Regulator Company, has been named to the newly created position of general manager. Wishart has been with Honeywell for 11 years, and since 1945 has been vice president-manufacturing in Minneapolis.

Houston Branch Offices Opened By Denison Engineering Company

Branch offices have been opened in Houston by Denison Engineering Company, Columbus, Ohio. The company manufactures oil hydraulic equipment, including the popular HydrOILic line of equipment. The Houston branch is headquarters for the company's southwestern sales and service operations.

Denison Neale, named manager of the Houston operations, has had experience in engineering, design and development of hydraulic equipment, with special emphasis on heavy industrial requirements.

Le Roi Company Reelects Board, Buchanan Returned As Chairman

Le Roi Company, Milwaukee manufacturer of portable air compressors, has reelected all members of its board of directors: W. C. Buchanan, E. O. Boshell, G. V. Meyers, James Carlson, T. O. Liebscher, P. W. Eells and R. R. Morgan.

W. C. Buchanan was reelected chairman of the board and T. O. Liebscher was reelected president of the company.

Mud Pump Developments Studied During Gardner-Denver Meeting

Continental Supply Company representatives met with Gardner-Denver Company representatives in November for a study group on latest mud pump developments. Metallurgy and physical properties of the special Gardner-Denver alloy used for mud pump fluid cylinders were among the subjects discussed. The group met in Quincy, Ill., following the annual API meeting in Chicago.

Le Roi Company Announces Promotion of Two Engineers

C. H. Bouvy has been promoted to chief design engineer at Le Roi Company. Bouvy, an engine designer with the Cadillac Division of General Motors Corporation until 1944, will be in charge of both engine and compressor design for Le Roi.

Henry Osterkamp has been named field research and development engineer for construction and mining equipment sales.

Glenn Huckaby Named Area Sales Representative for Baash-Ross

Baash-Ross Tool Company has appointed Glenn Huckaby sales representative in Southern Louisiana, Mississippi, and Alabama. He will make his headquarters at New Iberia, La. Huckaby is an engineering graduate of Arkansas A. & M. College and has been engaged in oilfield supply activities in Louisiana for the past six years.

Glen Resigns From Emsco

Hugh H. Glen's resignation as chairman of the board and a director of Emsco Derrick & Equipment Company was effective December 31. He was elected chairman of the board May, 1952, after having served as president of the company since 1939.

Tuboscope Appoints Mauldin

Tuboscope Company has appointed Ross Mauldin as sales engineer in South Louisiana and Mississippi. Mauldin has had 12 years experience in oil field servicing.

Continental Supply Intensifies Sales Territory Responsibility

The Continental Supply Company has created four new divisions and three new sub-divisions within its sales organization. The new divisions formerly operated as districts and have their headquarters in Tulsa, Fort Worth, Houston and Shreveport. R. A. Brewer, R. L. Collier, Raleigh Hortenstine, Jr., and E. N. Wood are division managers, respectively.

The new sub-divisions are composed of the southern half of Western Oklahoma, under supervision of Van C. Moore; New Mexico and a portion of West Texas under Glen R. Pike; and South Central Texas under R. F. Gregg. The foregoing men are all district managers.

Glen R. Pike

R. F. Gregg Van C. Moore

Other district managers are: L. C. Judy and J. R. Chapman for Arkansas-Mississippi-Louisiana-East Texas; H. J. McMann in Oklahoma City headquarters; R. O. Hambric in Wichita headquarters; W. T. Hays for the Permian Basin sector of West Texas; T. H. Fraser for North Texas; W. G. Sharp for Louisiana Gulf Coast region; Noble D. Lane for Southwest Texas, succeeding W. E. Young, who has been transferred to San Antonio as manager.

Allis-Chalmers Names Four New Sales Representatives

Allis-Chalmers Manufacturing Company recently named four new sales representatives to offices in the Southwest and Pacific regions. Byron E. Johnson, a graduate mechanical engineer of the Agricultural & Mechanical College of Texas, has been assigned to the Dallas district office. He had previously worked for the Fire Prevention and Engineering Bureau of Texas.

Melvin G. Williamson was named to the Fort Worth branch office. He recently completed Allis-Chalmers graduate training course. Charles J. Thiesen, an application engineer in the control section, was assigned to the Tulsa district office. Kenneth J. Fletcher, a recent Allis-Chalmers graduate, was assigned to Portland, Ore.

Webster Heads Hyatt Office

F. H. Webster has been appointed manager of the western division sales office, Chicago, by Hyatt Bearings Division of General Motors Corporation. He succeeds C. L. Newby, retired. Webster has been with Hyatt for the past 27 years.

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INDUSTRIAL GASOLINE ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N56	4	2¼	3½	56	14.2 @ 2200 RPM
N62	4	2⅛	3½	62	15 @ 2200 RPM
Y69	4	2½	3½	69	21.4 @ 2400 RPM
Y91	4	2⅞	3½	91	28.5 @ 2400 RPM
Y112	4	3⅛	3½	112	32 @ 2400 RPM
F124	4	3	4⅛	124	36 @ 2400 RPM
F140	4	3⅛	4⅛	140	42 @ 2400 RPM
F162	4	3⅜	4⅛	162	49 @ 2400 RPM
F186	6	3	4⅛	186	60.5 @ 2400 RPM
F209	6	3⅛	4⅛	209	68 @ 2400 RPM
F226	6	3⅜	4⅛	226	73 @ 2400 RPM
F244	6	3⅜	4⅛	244	79 @ 2400 RPM
M271	6	3½	4⅛	271	86.2 @ 2400 RPM
M290	6	3¼	4½	290	92.2 @ 2400 RPM
M330	6	4	4⅛	330	104.4 @ 2400 RPM
B371	6	4⅛	4½	371	110 @ 2400 RPM
B427	6	4⅜	4⅛	427	127 @ 2400 RPM
G134	4	3½	4⅛	134	32.2 @ 2000 RPM
G157	4	3½	4⅛	157	37.7 @ 2000 RPM
H227	4	3⅝	5½	227	54 @ 2000 RPM
H243	4	3¾	5½	243	58.2 @ 2000 RPM
*H260	4	3⅞	5½	260	62 @ 2000 RPM
T371	6	4⅛	4½	371	119 @ 2400 RPM
T427	6	4⅜	4⅛	427	140 @ 2400 RPM
U501	6	4½	5¼	501	160 @ 2400 RPM
R513	6	4½	5⅛	513	164.3 @ 2400 RPM
R572	6	4¾	5⅛	572	182.4 @ 2400 RPM
R602	6	4⅞	5⅛	602	191.7 @ 2400 RPM
S749	6	5⅛	5½	749	217 @ 2200 RPM

INDUSTRIAL DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
GD157	4	3½	4½	157	39 @ 2000 RPM
HD243	4	3¾	5½	243	54.7 @ 2000 RPM
*HD260	4	3⅞	5½	260	59.3 @ 2000 RPM
TD427	6	4⅜	4⅛	427	106.5 @ 2000 RPM
RD572	6	4¾	5⅛	572	142.5 @ 2000 RPM
SD802	6	5⅜	5½	802	184.3 @ 1800 RPM

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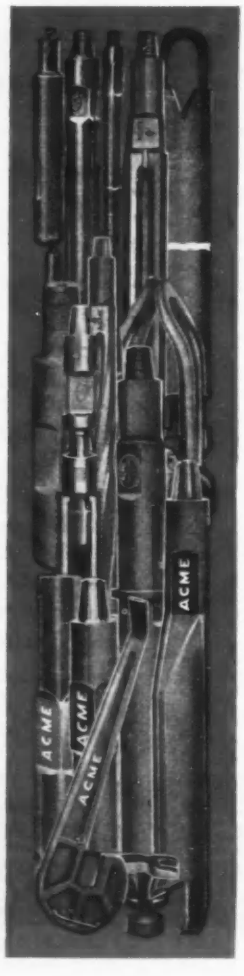

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

Oilfield Service Company Honors Nine With 20 Years Service

The Chemical Process Company honored nine men with 20-year-service pins and watches at its December managers' and department heads' meeting at Breckenridge, Texas. Awarded for long service were C. K. West, president of The Independent-Eastern Torpedo Company; G. R. Whitney, vice president of The Chemical Process Company Division; C. F. Hogan, purchasing agent and equipment manager; B. M. Kingston, technical advisor and assistant manager, all of Breckenridge; Paul W. Morrison, sales manager in Fort Worth; W. J. Smyrl, Treater, Wichita Falls, Texas; T. S. Lancaster, division manager in Oklahoma City; E. C. Efaw, district manager, Russell, Kansas; and Charles W. Burkett, district manager at Wichita.

The Chemical Process Company was founded in 1932 when C. K. West and P. W. Pitzer introduced some hydrochloric acid into a well which they owned in Breckenridge field.

Hammond Buys Keyes Division

Hammond Iron Works, Warren, Penn., has acquired Keyes Tank Company, Provo, Utah, and Keyes Tank & Suppy Company, Casper, Wyo. The newly acquired companies had been licensed to fabricate and sell Hammond designs of conservation storage tanks. Operation will be continued as the Keyes Tank Division of Hammond Iron Works. Lester Johnson and Donald Newell will continue as managers of the Casper and Provo plants respectively.

Frank Kelso Named West Texas Engineer for Martin Decker

Frank Kelso has been appointed West Texas service engineer for Martin Decker Corporation and will make his headquarters at Odessa, Texas. Kelso is a graduate of the University of California at Los Angeles.

Frank Kelso

During the war he served with the Merchant Marine and then joined Western Inspection Company. In his new duties he will be working with his father, Carroll Kelso, who is in charge of Martin-Decker operations in West Texas and New Mexico.

Bovaird Supply Company Reelects Board Members at Annual Meeting

Bovaird Supply Company which has a record for 82 years service to the oil industry, reelected the following to its board of directors during an annual meeting in Tulsa: Davis D. Bovaird, president; Frank D. Bovaird, vice president; Roscoe G. Ayers, vice president and sales manager; R. M. McMahan, secretary; R. E. Batchelor, general manager of sales; and A. E. Booth. Booth is from Bradford, Penn., while the others are located in Tulsa.

Totco Transfers Odessa Salesmen To New Mexico, Louisiana Posts

Technical Oil Tool Corporation transferred two Totco representatives recently. Bob Scott, formerly a salesman at Odessa, Texas, has been moved to Hobbs, N. M., to reinforce the two men already in the busy New Mexico area.

Another Odessa representative, Bud Gibbs, has been transferred to the New Iberia-Lake Charles-Eunice, La., area to succeed Gene McCann, resigned.

Bishop Named General Manager

James F. Bishop, secretary-treasurer of American Hoist and Derrick Company, has been appointed general manager in addition to his present duties. A veteran of 30 years service with American Hoist, Bishop has been secretary-treasurer since 1945 and a member of the board of directors since 1951. He has been with the company since 1923.

Concrete Company Has Election

Myron W. Krueger was elected vice president of Raymond Concrete Pile Company and Henry A. Federa, secretary, in a recent election. Krueger joined the company in 1948 as treasurer and became a director in 1951. Federa was formerly associated with Orinoco Mining Company.

Brodie Opens Dallas Office

New Mid Continent division offices in Dallas have been opened by The Ralph N. Brodie Company, Inc. J. J. Kropp is manager of the Dallas organization which comprises a staff of sales engineering and service personnel. The Dallas office will provide service for and stock Brodie meters and parts.

H. A. Nystrom

Clark Edgecomb

Four Appointed to Houston By Schlumberger Promotions

Four new appointments to Houston headquarters of Schlumberger Well Surveying Corporation named L. A. Allaud, H. A. Nystrom, R. K. Thies, and Clark Edgecomb.

L. A. Allaud

Allaud, named technical assistant to the vice president, joined Schlumberger in Paris in 1935 and was sent to the U. S. in 1936 as an engineer in New Iberia, La. He has served as division manager in Wichita and area manager in Tulsa. In 1948 he was transferred to Surenco and served in South America. Since March, 1952, he has been in Fort Worth as assistant to the Northwest Texas area manager.

Nystrom was named technical assistant to the vice president. He is a University of Minnesota physics graduate, he joined Schlumberger in 1937. He has served in Louisiana and Texas, as district manager at Mt. Vernon, Ill., and Reed City, Mich. He moves up from his former capacity as division manager at Gretna.

Thies, newly appointed assistant to the vice president, personnel relations, graduated from the University of Colorado and joined Schlumberger in 1939. He served at Corpus Christi, Houma, Lake Charles, Jackson and Winfield, La., before entering the U. S. Navy in 1943. Since 1945 he has been in Shreveport and then Tyler as district engineer.

Edgecomb, new assistant to the sales manager, joined Schlumberger in 1943 and has worked in both Long Beach and Ventura, Calif.

Worthington Corporation Names August and Berman in Promotions

Irving August, superintendent of Worthington Corporation's Denver plant, was recently appointed assistant to the Works manager of the Holyoke, Mass., plant. August is succeeded at Denver by Merril Berman.

August is a graduate of Northeastern University in mechanical engineering and has served with Worthington since 1937 in the Centrifugal Pump and Vertical Turbine Pump divisions.

Berman joined Worthington in 1943 upon graduating from Northeastern University in mechanical engineering. He was employed first in the Research and Development division and in 1945 was transferred to the Centrifugal Engineering division. In 1947 he was appointed product engineer in the Vertical Turbine Pump division at Harrison, N. J. He will make his home at Wheatridge, Colo.

Colorado Fuel and Iron Makes Two Managerial Appointments

The Colorado Fuel and Iron Corporation has appointed John V. Boardman works manager of the Claymont Plant. Boardman is a graduate of the University of Michigan and Carnegie Institute of Technology and served with Jones and Laughlin Steel Corporation for 18 years. He joined Worth Steel Company in 1946 and became part of The Colorado Fuel and Iron Corporation when it merged with Worth.

In addition Fordyce Coburn was made district manager-operations for the E. & G. Brooke, Claymont and Buffalo plants. Coburn is a graduate of Massachusetts Institute of Technology. Prior to their merger with The Colorado Fuel and Iron Corporation he served as vice president of E. & G. Brooke Company and the Richard Ore Company.

Mid-State Expands Home Plant

Mid-State Chemical Company, Inc., Mt. Vernon, Ill., opened a new plant and warehouse on Fairfield Road in Mt. Vernon on December 13.

Colt Is Airco District Manager

Henry F. Colt, Jr., was lately appointed district manager at El Paso, Texas, for Air Reduction Magnolia Company. The El Paso district encompasses stores and plants at El Paso and Hobbs, N. M. A Harvard graduate, Colt gained sales experience with Airco at New York, Pittsburgh, and Johnstown, Penn.

Sperry-Sun Moves Southwest Headquarters to Corpus Christi

Sperry-Sun Well Surveying Company has moved its Southwest Texas offices from Falfurrias, Texas, to Corpus Christi. E. J. Blackburn, formerly of the Houston district, was promoted to district manager of the Southwest district. He will be assisted by H. J. James, sales engineer and V. S. Mueck, salesman.

B. A. Cabaniss, formerly district manager of the Southwest district, was transferred to Lafayette, La., to manage the Louisiana and Mississippi territory. Cabaniss has worked with the company for nine years as sales engineer and district manager.

Colorado Fuel & Iron Appoints Manager for New Colorado Plant

R. E. Metzger, Denver, has been appointed manager of Tubular Sales for The Colorado Fuel and Iron Corporation. The appointment is a preliminary step to the operation of a new seamless tube mill at Pueblo, Colo., now scheduled to start production in the early fall of 1953.

Metzger is a graduate engineer of the Colorado School of Mines. He joined CF&I in 1945 following discharge from war service.

Geological Logging Appointment

Geological Logging Company of Houston has appointed Jack Covin manager of the New Orleans office. A native of Marshall, Texas, he graduated from Rice Institute in 1929 and has been engaged in oil well service work for the past ten years.

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6 1/16"	W7R	28	1	3 1/2"
7 7/8"	W7R	42	1	3 1/2"
9"	HR	75	4	4 1/2"
9 7/8"	W7	112	1	6 5/8"
9 7/8"	OSC	112	214	6 5/8"
11"	OSQ2	136	1	6 5/8"
12 1/4"	OSQ2	165	6	6 5/8"

HUGHES TYPE "J" CORE BIT HEADS

4 1/8"	HF	10	7
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4 7/8"	HF	13	53
5"	HF	18	5
5 1/8"	SF	18	3
5 1/8"	HF	18	3
5 7/8"	SF	25	2
6 3/4"	HF	30	23
7 7/8"	HF	49	25
7 7/8"	HF	55	12
9"	HF	70	17

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6 1/16"	BR PCC PCC-2C	40	9
6 1/4"	BR PCC PC-2	22	1
6 3/4"	BR PCC PC-2	25	1
7 7/8"	CP1 CP1	80	11
7 7/8"	PCC PC2	80	36
7 7/8"	PCC Soft	12	5
7 7/8"	PCC CP-2C	80	5
9"	PCC PC-2C	53	29
11"	Drag	80	2

REED ROLLER BEARING ROCK BITS

4 1/2"	M	12	1	2 3/4"
6 3/4"	SEM	27	1	3 1/2"
7 7/8"	SE-2C	42	6	3 1/2"
8 1/2"	SEM	68	29	4 1/2"
8 1/2"	M	68	9	4 1/2"
8 1/2"	SE-2C	68	12	4 1/2"
8 3/4"	DK2C	78	2	4 1/2"
9"	2-AA	71	1	4 1/2"
11"	T	132	7	
11"	2T	132	23	
12 1/4"	2T	154	8	
12 1/4"	M	154	16	
12 1/4"	2HM	154	25	
16"	T	270	2	

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MISCELLANEOUS

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McCullough Tool Assigns Utah Service Branch to C. N. Bilbey

McCullough Tool Company has appointed Charles N. Bilbey manager of the Vernal, Utah, service branch. Bilbey, with the company for five years, served as field service engineer at Bakersfield, Calif., and in 1950 was transferred to Edmonton, Canada, as assistant manager of the McCullough service branch there. Prior to joining McCullough, Bilbey had 13 years of oil field experience as a tool pusher and driller.

Perrault Brothers Sell Interest

Perrault Brothers, Tulsa, recently sold assets in their pipe line cleaning and priming machines and pipe line coating and wrapping machines activities to W. O. Dixon, Wichita, Kansas. A new company, Perrault Equipment Company, has been organized. R. E. Shackelford, general manager of Perrault Brothers, continues as general manager of the equipment company.

Stewart & Stevenson Promotion

Stewart & Stevenson has promoted Joe Rucker, formerly of the service department, to the sales department of its Odessa service branch. He has been with the company since early 1952 when the Odessa branch was opened.

Kuether Named Le Roi Engineer

Frank Kuether was named executive engineer recently by Le Roi Company, Milwaukee, manufacturers of portable air compressors. Kuether joined Le Roi in 1926 upon transfer of the Beaver Motor Corporation to Le Roi. Kuether will be responsible for operation of the Engineering division.

Honeywell Transfers Vanderveld

Minneapolis-Honeywell Regulator Company has transferred James E. Vanderveld from Boston where he served in the Brown Instruments Division, to Portland, Maine, where he will be industrial sales manager.

Franks Announces Export Appointee

Franks Manufacturing Corporation, Tulsa, has appointed Joe M. Rutledge as assistant export representative in the New York Office. He will assist A. V. Simonson, export manager.

Milwaukee Office for Chiksan

Chiksan Company, manufacturers of ball-bearing swivel joints, has opened a new sales office in Milwaukee and appointed Bev Ragsdale manager. Ragsdale previously covered the Rocky Mountain territory from headquarters in Salt Lake City.

New Books, Maps and Movies

WATER FLOODING OPERATIONS IN INDIANA TO 1951, Interstate Oil Compact Commision, Box 3127, State Capitol, Oklahoma City 5, Okla.

This booklet was prepared by the Secondary Recovery Committee for Indiana in cooperation with the Secondary Recovery Division of the Interstate Oil Compact Commission. The report contains data on eight water flooding operations, three of which are described. Maps, graphs and charts depict conditions or histories of seven of the projects.

OIL AND PETROLEUM YEAR BOOK FOR 1952, Walter E. Skinner, 20 Copthall Avenue, London, E. C. 2. $4 ppd.

This standard reference work contains data on 800 operating companies in all parts of the world and covers all branches of the oil industry. It also covers a list of names and addresses of 512 managers and engineers and the companies with which they are connected. The "Buyers' Guide of Manufacturers," oilfield and refinery equipment, comprises 737 headings.

PLANNED INDUSTRIAL PUBLICITY, George Black, Putman Publishing Company, 113 East Delaware Place, Chicago 11. $2.95.

This is a guide to the purpose, scope, operation and evaluation of a planned program of industrial publicity. Analysis of need for a planned program, details of how to create an effective program, and discussion of the integration of publicity with sales promotion, public relations and market research are all covered.

OPPORTUNITIES IN THE PETROLEUM INDUSTRY. Gene Patrick. Vocational Guidance Manuals, New York.

Young people preparing for careers in the oil industry will have some questions of first importance answered in this book prepared by an Oil Industry Information Committee specialist in public and personnel relations. Naming fields, Patrick also relates what remuneration the young careerist may expect. Comparison of benefits with more than 150 top ranking industries are made.

PRACTICAL PREVENTIVE MAINTENANCE, by James H. Caldwell. The Cooper-Bessemer Corporation, Mount Vernon, Ohio, Att'n H. T. Watson. Two volumes. $2 each.

Complete programs for care of engines are outlined in these two manuals, one of which covers gas engines, and the other gas-diesels and diesels. The author, a Cooper-Bessemer service engineer, sets forth day-to-day procedures for keeping the equipment at optimum efficiency with minimum downtime for repairs.

In contrast to the usual periodic 8000-hour over-all check or the progressive-type maintenance schedule, the manuals show how to perform continuing checks on engines while in service to accurately forecast internal conditions of the engines and anticipate operational needs.

THE MINERAL RESOURCES OF THE WORLD, Volume II of Atlas Series, University of Maryland and Prentice-Hall, Inc. 70 Fifth Avenue, New York 11.

This atlas centers about a petroleum report prepared by Dr. John W. Frey, API Marketing director. The volume is edited by Dr. William van Royen, University of Maryland, Department of Geography and Dr. Oliver Bowles, Research; with Elmer W. Pehrson, U. S. Bureau of Mines. The text discusses the chemistry and occurrence of petroleum, exploration and discovery, drilling, production, transportation, refining and world reserves.

DISPLACEMENT GAS METER HAND BOOK, John C. Diehl, American Meter Company, 1513 Race Street, Philadelphia. $4.50.

This comprehensive handbook, in reprint edition already, deals authoritatively on displacement gas meters. The text draws on the American Meter Company experience collected over a period of 115 years. All phases of displacement meters are covered from fundamental principles of gas measurement to proving, maintenance and repair of tinned steelcase and ironcase meters.

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SQUEAKS from the BULLWHEEL

Ghost Writer

An oil man was reading a prepared address at an association meeting and he swung into his speech:

"The average oil man is tired. He has worked long and diligently in difficult times and he is weary. He is physically and mentally exhausted. But he isn't nearly as tired as the girls who have to type all this hogwash."

There came a long tense pause, then the delighted audience began to yelp its appreciation. The speaker stared at his script in unbelief.

"Why," he blurted at last, "I never wrote anything like that!"

•

Playing It Safe

The three germs inside the sick man had just heard the doctor say that he was going to give his patient a heavy dosage of penicillin the next morning and they were holding a council of war.

"That penicillin is rough stuff," said one. "I'm going to crawl clear out on to a hair follicle and maybe I'll be safe there."

"I'm going to get under this man's great toenail—I'll be safe there," said the second.

"You two bugs can do as you like," said the third. "But as for me I'm going to take the 8:30 B.M. and get out of here."

•

Only Semi-Transformation

Some women may get a school girl complexion down at the corner drug store, but they can't buy the giggle and wiggle to go with it.

Quite Obvious

A tramp knocked on the door of an inn known as "George and the Dragon." When the landlady opened the door the tramp asked:

"Could you spare a hungry man a bite to eat?"

"No!" snapped the woman, slamming the door.

The tramp knocked again and slipped his foot in as the woman opened the door. "Could I speak to George?"

•

Comparative Shopper

A widower noticed that his son seemed rather interested in his pretty secretary. He determined to speak to the girl, but before he got around to it she announced that the son had proposed and she had accepted.

"Well, said the widower, "I think you might have seen me first."

"I did," his secretary replied, "but I preferred your son."

•

Three Little Words

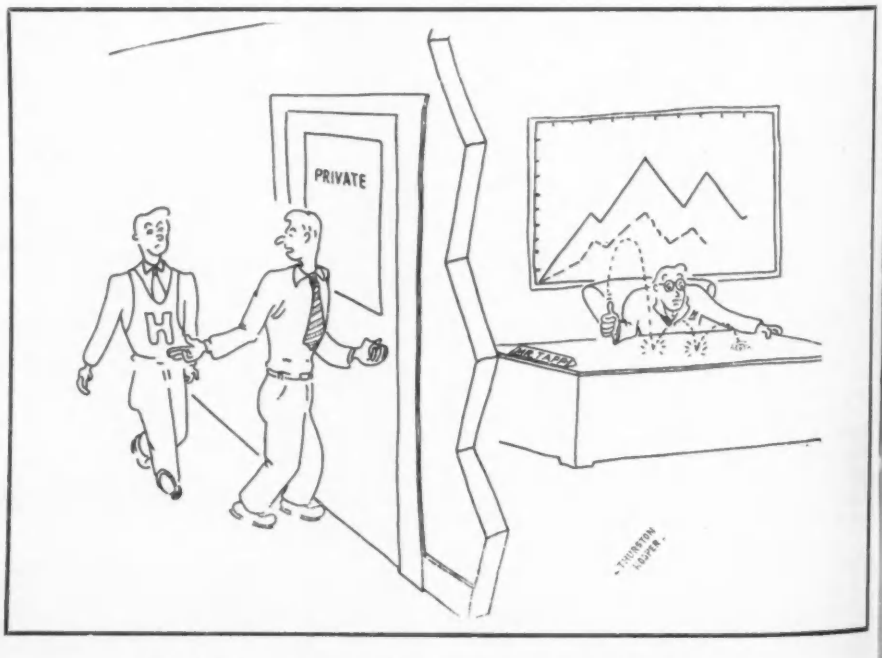
He: "Tell me those three words which will send me floating up to heaven."

She: "Go hang yourself."

•

That's for the Birds!

Papa Robin returned to the nest and announced rather proudly that he had just made a deposit on a new Buick.



"And this is the office of Mr. Tapp—he makes all final decisions."

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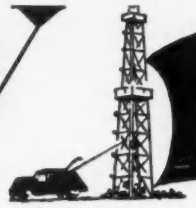

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. . . How simple, scientific design provides greater power and deeper penetration

. . . A series of penetration tests covering all sizes of McCullough Burrless Bullet Perforators

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Beyond Fear

The newly-appointed colonial officer arrived at his African outpost in Kenya to find his new chief drowning all his nostalgia for the Kiplingesque days of yore in whiskey.

The old swizzler was in a chair on the porch. Around his feet and curling about the legs of the table on which stood countless whiskey bottles were swarms of snakes.

"Excuse me, sir," said the young man, "but don't all those snakes worry you?"

"No, m'boy, not a bit," the colonial veteran responded. "They did, though, they did . . . until I found they were real."

•

Alarming Prospect

A proud father was looking through the window of the hospital's infant ward. Every baby there was crying lustily.

"What's the matter in there?" asked the new father.

"Well," replied the attending nurse, "if you were only a few days old, out of a job, and owed the government $2050, you'd be bawling too."

•

Exit a Mink

When the little mink died and went to heaven, St. Peter told him: "We haven't had any mink up here before, so we don't know exactly what to do for you. However, you were a very good little mink on earth, and we will give you whatever you want."

"Please, St. Peter," said the mink, "Could I have a coat made of chorus girls?"

•

Knew He'd Arrived

"We are now passing the largest brewery in Milwaukee," exclaimed the guide.

"Not me," said the tourist as he hopped off the bus.

"I could probably find a better job, but this oil business gets into your blood."

Piped Aboard

The deaf old lady went to live near one of the naval ports. Shortly afterwards, a battleship fired a salute of ten guns. The old lady, who lived alone, got out of her chair, smoothed down her dress, patted her hair, and said sweetly, "Come in."

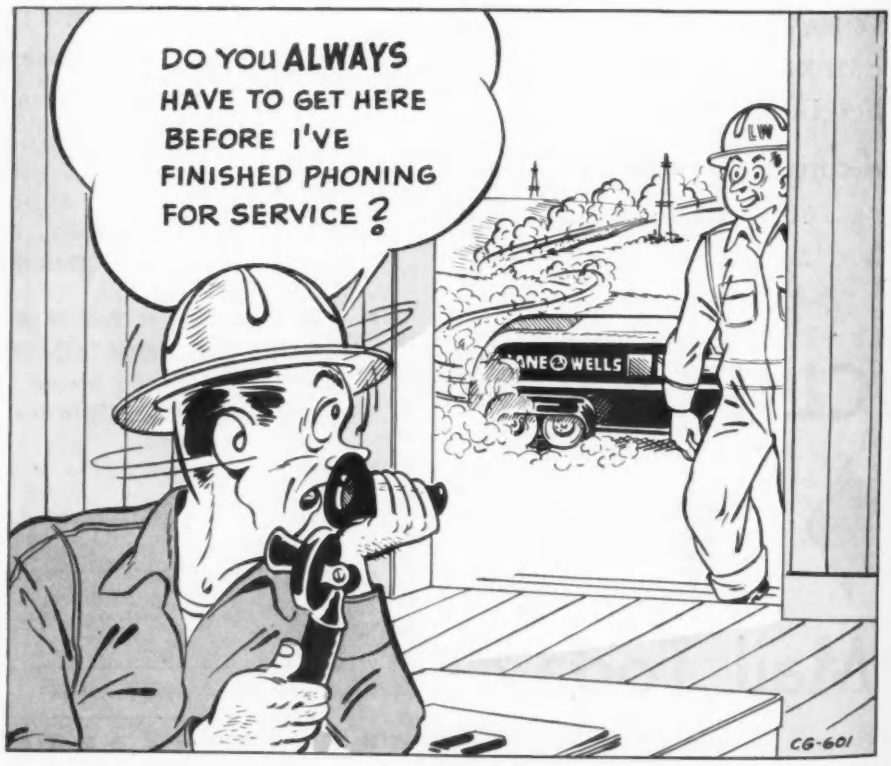
•

Public Confession

A sign in front of a shoe repair shop pictured several styles of rubber heels and a beautiful girl who was saying, "I'm in love with America's No. One Heel." Underneath in small feminine handwriting someone had added, "Too bad, sister. I married him."

•

All Mistakes Fatal

"How many successful jumps must a paratrooper make before he graduates?"

"All of them."